

Devices and Mn/DOT Specifications 1404 and 1710, and the Special Provisions. Neither road closures nor detours shall be permitted unless specified in the Special Provisions or authorized by the Engineer. Where road closures or detours are permitted by the Engineer, the Engineer shall determine the appropriate agencies, boards, or departments the Contractor must notify prior to taking the action and the proper advance notice to be provided to each body.

Compliance with this requirement shall not be construed to relieve the Contractor from the responsibility of notifying agencies or institutions whose services may be predicated upon a roadway being opened to traffic or whose services would be hindered if a roadway is closed to traffic. Such agencies or institutions shall include, but not be limited to, the police department, the fire department, municipal bus service, school bus service, and ambulance service. The Contractor shall keep the required agencies informed of changing traffic patterns and detour situations.

A2 Establishing Line and Grade

Unless otherwise specified in the Plans, Specifications, and Special Provisions, the watermain shall generally be placed with 7 feet of cover. However, a slightly greater depth may be required to clear existing storm and sanitary sewers and sewer services, and no additional compensation shall be provided for such adjustments.

In certain locations where the watermain is in direct conflict with storm or sanitary sewer, the watermain shall be constructed under the sewer. Where it is necessary to use vertical bends to avoid sewer mains, no extra compensation will be made for this construction. However, fittings will be a unit of measurement and payment.

No deviation shall be made from the required line or grade except with the consent of the Engineer.

Watermains crossing house above sewers, storm sewers, or sanitary sewers shall be laid to provide a separation of at least 18 inches between the bottom of the watermain and the top of the sewer. When local conditions prevent a vertical separation as described, the following construction shall be used:

- (1) Sewers passing over or under watermains shall be constructed of materials equal to watermain standards of construction for a distance of at least 9 feet on either side of the watermain.

- (2) Watermain passing under sewers shall, in addition, be protected by providing:

a vertical separation of at least 18 inches between the bottom of the sewer and the top of the watermain;

adequate structural support for the sewers to prevent excessive deflection of joints and settling on and breaking of the watermains;

that the length of water pipe be centered at the point of crossing so that the joints will be equidistant and as far as possible from the sewer.

Watermains shall be laid at least 10 feet horizontally from any sanitary sewer, storm sewer or sewer manhole, whenever possible. When local conditions prevent a horizontal separation of 10 feet a watermain may be laid closer to a storm or sanitary sewer provided that:

- (1) the bottom of the watermain is at least 18 inches above the top of the sewer;

- (2) where this vertical separation cannot be obtained, the sewer shall be constructed of materials and with joints that are equivalent to watermain standards of construction and shall be pressure tested to assure watertightness prior to backfilling.

The primary line and grade will be established by the Engineer. For trench installation, line and grade stakes will be set parallel to the proposed pipeline at an appropriate offset therefrom as will best serve the Contractor's operations wherever practical. For tunnel installation, line and grade stakes will be set directly above the proposed pipeline setting. Grade and line stakes will be set at 25-foot intervals along the pipeline; at each change in line or grade; and as needed for pipeline appurtenances and service lines.

The Contractor shall arrange operations to avoid unnecessary interference with the establishment of the primary line and grade stakes; and shall render whatever assistance may be required by the Engineer in accomplishing the staking. The Contractor shall be responsible for preservation of the primary stakes and, if negligent in providing necessary protection, shall bear the full cost of any restaking.

moved to an existing joint, concrete structures shall be sawed along the break lines to a minimum depth of one-third of the structure depth.

Any reusable materials generated during the work, such as aggregate, sod, topsoil, shall be segregated from other waste materials and be stockpiled so as to maintain suitability and permit proper reuse.

The use of drop weight equipment for breaking pavement will be allowed to the extent that the Contractor shall assume full responsibility for any damages caused thereby. The pavement breaking operation shall not be allowed to become a nuisance to the public or a source of damage to underground or adjacent structures. The Engineer reserves the right to order discontinuance of drop weight breaking operations at any time.

A6 Temporary Service Measures

While any open excavations are maintained, the Contractor shall have available a supply of steel plates suitable for temporary bridging of open trench sections where either vehicular or pedestrian traffic must be maintained. Use of the plates shall be as directed or approved by the Engineer and where installed they shall be secured against possible displacement and be replaced with the permanent structure as soon as possible.

B Excavation and Preparation of Trench

B1 Operational Limitations and Requirements

Excavating operations shall proceed only so far in advance of pipe laying as will satisfy the needs for coordination of work and permit advance verification of unobstructed line and grade as planned. Where interference with existing structures is possible or in any way indicated, and where necessary to establish elevation or direction for connections to in-place structures, the excavating shall be done at those locations in advance of the main operation so actual conditions will be exposed in sufficient time to make adjustments without resorting to extra work or unnecessary delay.

All installations shall be accomplished by open trench construction except for short tunnel sections approved by the Engineer and with the exception that boring and jacking or tunnel construction methods shall be employed where so specifically required by the Plans, Specifications, or Special Provisions.

Installation of pipe through tunnel excavations shall be properly supported and only where the surface structure can be properly supported and the backfill restored to the satisfaction of the Engineer.

The excavating operations shall be conducted so as to carefully expose all in-place underground structures without damage. Wherever the excavation extends under or approaches so close to an existing structure as to endanger it in any way, precautions and protective measures shall be taken as necessary to preserve the structure and provide temporary support. Hand methods of excavating shall be utilized to probe for and expose such critical or hazardous installations as gas pipe and power or communication cables.

The Engineer shall be notified of any need for blasting to remove materials which cannot be broken up mechanically, and there shall be no blasting operations conducted until the Engineer's approval has been secured. Blasting will be allowed only when proper precautions are taken to protect life and property, and then shall be restricted as the Engineer directs. The Contractor shall assume full responsibility for any damages caused by blasting, regardless of the requirements for notification and approval. The Contractor shall secure any required permits for blasting and shall conduct blasting operations in conformance with all applicable state and local laws, regulations and ordinances.

B2 Classification and Disposition of Materials

Excavated materials will be classified for payment only to the extent that the removal of materials is classified by the Engineer as Rock will be paid for separately from other unclassified materials, either as a separate contract item or as an Extra Work Item when no bid price is applicable. All other materials encountered in the excavations, with the exception of items classified for payment as structure removals, will be considered as Unclassified Excavation and unless otherwise specified in the Plans, Specifications, and Special Provisions, no additional compensation shall be provided for their removal. Unclassified materials shall include muck, rubble, wood debris, and boulder stone, masonry or concrete fragments less than one cubic yard in volume, together with other miscellaneous matter that can be removed effectively with power operated excavators without resorting to drilling and blasting.

Rock excavation shall be defined to include all hard, solid rock in ledge formation, bedded deposits and unstratified masses; all natural conglomerate deposits so firmly cemented as to

damage to the work under contract or to adjacent structures or property caused by settlement, water or earth pressures, slides, cave-ins, or other causes due to failure or lack of sheeting, shoring, or bracing or through negligence or fault of the Contractor in any manner shall be repaired at the Contractor's expense and without delay.

Where conditions warrant extreme care, the Plans, Specifications, and Special Provisions may require special precautions to protect life or property, or the Engineer may order the installation of sheet piling of the interlocking type or direct that other safety measures be taken as deemed necessary. Failure of the Engineer to order correction of improper or inadequate sheeting, shoring, or bracing shall not relieve the Contractor's responsibilities for protection of life, property, and the work.

The Contractor shall assume full responsibility for proper and adequate placement of sheeting, shoring, and bracing, wherever and to such depths that soil stability may dictate the need for support to prevent displacement. Bracing shall be so arranged as to provide ample working space and so as not to place stress or strain on the in-place structures to any extent that may cause damage.

Sheeting, shoring and bracing materials shall be removed only when and in such manner as will assure adequate protection of the in-place structures and prevent displacement of supported grounds. Sheetting and bracing shall be left in place only as required by the Plans, Specifications, and Special Provisions or ordered by the Engineer. Otherwise, sheeting and bracing may be removed as the backfilling reaches the level of respective support. Wherever sheeting and bracing is left in place, the upper portions shall be cut and removed to an elevation of three feet or more below the established surface grade as the Engineer may direct.

All costs of furnishing, placing and removing sheeting, shoring, and bracing materials, including the value of materials left in place as required by the Contract, shall be included in the prices bid for pipe installation and will not be compensated for separately. When any sheeting, shoring, or bracing materials are left in place by written order of the Engineer, in the absence of specific requirements of the Contract to do so, payment will be made for those materials as an Extra Work Item, including waste material resulting from upper cut-off requirements.

B5 Preparation and Maintenance of Foundations

Foundation preparations shall be conducted as necessary to produce a stable foundation and provide continuous and uniform pipe bearing between bell holes. The initial excavating or backfilling operations shall produce a subgrade level slightly above finished grade as will permit hand shaping to finished grade by trimming of high spots and without the need for filling of low spots to grade. Final subgrade preparation shall be such as to produce a finished grade at the centerline of the pipe that is within 0.03 foot of a straight line between pipe joints and to provide bell hole excavation at each joint as will permit proper joining of pipe and fittings.

In excavations made below grade to remove rock or unstable materials, the backfilling to grade shall be made with available suitable materials unless placement of granular foundation or bedding material is specified and provided for or is ordered by the Engineer as an Extra Work Item. Placement of the backfill shall be in relatively uniform layers not exceeding 8 inches in loose thickness. Each layer of backfill shall be compacted thoroughly, by hand or by means of approved mechanical compaction equipment, as will produce uniform pipe support throughout the full pipe length and facilitate proper shaping of the pipe bed.

Where the foundation soil is found to consist of materials that the Engineer considers to be so unstable as to preclude removal and replacement to a reasonable depth to achieve solid support, a suitable foundation shall be constructed as the Engineer directs in the absence of special requirements therefor in the Plans, Specifications, and Special Provisions. The Contractor may be required to furnish and drive piling and construct concrete or timber bearing supports or other work as may be provided for in an Extra Work order.

Care shall be taken during final subgrade shaping to prevent any over-excavation. Should any low spots develop, they shall only be filled with approved material, which shall have optimum moisture content and be compacted thoroughly without additional compensation to the Contractor. The finished subgrade shall be maintained free of water and shall not be disturbed during pipe lowering operations except as necessary to remove pipe slings. The discharge of trench dewatering pump shall be directed to natural drainage channels or storm water drains. Draining trench water into sanitary sewers or combined sewers will not be permitted.

At all times when pipe laying is not in progress, including noon hour and overnight periods, all open ends of the pipe line shall be closed by watertight plugs or other means approved by the Engineer. If water is present in the trench, the seals shall remain in place until the trench is pumped completely dry.

When connecting to existing stubs, the Contractor shall take every precaution necessary to prevent dirt or debris from entering the existing lines. All necessary work to make the connection shall be done at no additional compensation, except where noted otherwise.

C3 Aligning and Fitting of Pipe

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 and so as to leave a smooth square-cut end. Pipe shall be cut with approved mechanical cutters. The electric-arc cutting method, using carbon or steel rod, will be approved for use on larger size ductile or gray pipe where mechanical cutters are not available. Flame cutting will not be allowed under any conditions. All rough edges shall be removed from the cut ends of pipe and, where rubber gasket joints are used, the outer edge shall be rounded or beveled by grinding or filing to produce a smooth fit.

Wherever it is necessary to deflect ductile or gray iron pipe from a straight line either in the vertical or horizontal plane, to avoid obstructions, plumb stems, or produce a long radius curve when permitted, the amount of deflection allowed at each joint shall not exceed the allowable limits for maintaining a satisfactory joint seal as given in AWWA C-600 for mechanical joints and push-on joints. The maximum angular deflection at any joint for other pipe materials and joints shall not exceed the manufacturer's recommendations. If the specified alignment requires angular deflections greater than recommended or allowed, the Contractor shall provide appropriate bends or shorter pipes such that the maximum angular deflection is not exceeded.

Connection and assembly of joints shall be accomplished during the setting, aligning, and fitting operations, in accordance with the provisions of Section 2611.2D, to the extent that the jointing requirements will permit.

C4 Blocking and Anchoring of Pipe

All plugs, caps, tees, bends, and other thrust points shall be provided with reaction backing, or movement shall be prevented

by attachment of suitable restraining devices, in accordance with the requirements of the Plans, Specifications, and Special Provisions.

In the absence of other specified requirements for reaction backing or restraining devices, the following provisions shall apply:

- (1) All horizontal bends exceeding 20 degrees deflection, and all caps, plugs, and branch tees shall be provided with concrete buttress blocking.
- (2) All vertical bends exceeding 20 degrees deflection shall be provided with concrete buttress blocking at the low points and with metal tie rod or strapping restraints at the high points.
- (3) Offset bends made with standard offset fittings need not be strapped or buttressed.

Hardwood blocking shall only be used as temporary reaction backing until acceptable permanent reaction blocking or restraining devices have been installed. Blocking shall be nominal 2-inch timber having an area equivalent to at least four times the area of the surface of the cap or plug it restrains.

Concrete buttresses shall be poured against firm, undisturbed ground and shall be formed in such a way that the joints will be kept free of concrete and remain accessible for repairs. The concrete mix used in buttress construction shall meet the requirements for Grade B of Mn/DOT Specification 2461. Buttress dimensions shall be a minimum of 12 inches in thickness, and the minimum area, in square feet shall be as follows.

PIPE SIZE	TEE OR PLUG	1/32 BEN AND		
		1/4 BEND	1/8 BEND	1/16 BEND
6"	2.9	3.1	1.6	0.8
8"	3.7	5.3	2.9	1.4
10"	5.7	8.1	4.4	2.2
12"	8.1	13.4	6.6	3.2
16"	15.1	21.4	11.6	5.9
20"	23.2	30.2	18.1	9.3
24"	33.6	48.5	26.1	13.3

1-1/2 inches or greater. The material shall be placed in such a manner that construction equipment does not operate directly on the insulation and shall be compacted with equipment which exerts a contract pressure of less than 80 psi. The first layer shall be compacted until there is no further visual evidence of increased consolidation or the density of the compacted layer conforms to the density requirements specified in the Special Provisions.

D Connection and Assembly of Joints

Where rubber gasketed joints are specified, care shall be taken during the laying and setting of piping materials to insure that the units being joined have the same nominal dimension of the spigot outside diameter and the socket inside diameter. A special adaptor shall be provided to make the connection when variations in nominal dimension might cause unsatisfactory joint sealing.

Immediately before making the connection, the inside of the bell or socket and the outer surface of the spigot ends shall be thoroughly cleaned to remove oil, grit, excess coating, and other foreign matter. Insertion of spigot ends into the socket or bell ends shall be accomplished in a manner that will assure proper centering and insertion to full depth. The joint seal and securing requirements shall be as prescribed below for the applicable pipe and joint type.

D1 Ductile Iron Pipe Joints

D1a Push-On Joints

The circular rubber gasket shall be kept in a warm, flexible condition at all times, and for purposes of placement shall be flexed inward and inserted in the gasket recess of the bell socket. A thin film of approved gasket lubricant shall be applied to either the inside surface of the gasket or the outside surface of the spigot end, or to both. Care shall be taken while inserting the spigot end to prevent introduction of contaminants. The joint shall be completed by forcing the spigot end to the bottom of the socket by the use of suitable pry-bar or jack type equipment. Spigot ends which do not have depth marks shall be marked before assembly to insure full insertion. Field cut pipe shall be filed or ground at the spigot edge to resemble the manufacturer's fabricated detailing. The use of the bucket on the excavation equipment to force the pipe into the socket shall not be permitted.

D1b Mechanical Joints

The last eight inches of the outside spigot surface and the inside bell surface of each pipe and appurtenance joint shall be painted with a soap solution, after being thoroughly cleaned. The gland shall then be slipped on the spigot end with the 1/4" extension toward the socket or bell end. The rubber gasket shall be kept in a warm, flexible condition at all times, and for purposes of placement shall be painted with soap solution and placed on the spigot end with the thick edge toward the gland. An approved lubricant provided by the pipe manufacturer may be used in lieu of the soap solution.

After the spigot end is inserted into the socket to full depth and centered, the gasket shall be pressed into place with the bell evenly around the entire joint. After the gland is positioned behind the gasket, all bolts shall be installed and the nuts tightened alternately to the specified torque, such as to produce equal pressure on all parts of the gland.

Unless otherwise specified, the bolt shall be tightened by means of a suitable torque-limiting wrench to within a foot-pound range of: 45 to 60 for 5/8 inch bolts; 75 to 90 for 3/4 inch bolts; 85 to 100 for 1 inch bolts; and 105 to 120 for 1-1/4 inch bolts. After tightening, all exposed parts of the bolts and nuts shall be completely coated with an approved asphaltic type rust-preventive material.

D2 Concrete Pressure Pipe Joints

Unless otherwise indicated, all pipe and appurtenances shall be joined by means of the rubber gasketed bell and spigot connection in accordance with the recommendations of the pipe manufacturer and the provisions hereof. All contact surfaces of the steel bell and spigot assembly shall be thoroughly lubricated with approved material before the connection is made.

After the joint has been set in the same position, the outside joint recess shall be filled with cement grout, poured into place by means of a paper or cloth diaphragm. The grout shall contain at least one part Portland cement for each two parts of sand. Care shall be taken in pouring the grout to assure complete filling of the recess around the entire pipe circumference.

and larger may be furnished in standard cut-lengths of 20 feet or longer and be joined with approved couplings, provided that the installation of pipe less than full standard length in any run shall be limited to the needs for closure. All pipe and appurtenances shall be joined by means of approved flared or compression type threaded couplings.

Unless otherwise specified, connection of tap service lines to the water main shall be made with an approved corporation stop and saddle, with the water main tap being made at an angle of not more than 22 degrees from the horizontal. A double wrap of rayon tape shall be placed on the corporation stop threads prior to installation in the main. Expansion loops shall be directed downward from the tap. One and one-half and two inch service pipe shall have a 45 degree bend connected to the corporation stop to facilitate the downward expansion loop.

Unless otherwise indicated, tap service lines shall be installed on a straight line at right angles to the water main or property line as directed by the Engineer. Service lines shall extend for such distance beyond the curb stops as may be specified in the Contract. In the absence of specific requirements, the service line shall be terminated at the property line, where it shall be connected to an existing line or, in the case of undeveloped property, it shall be capped, plugged, or peened as approved by the Engineer.

The flaring of copper tubing ends shall be accomplished only with the use of the proper size and type of tools as designed for the purpose, such as will provide accurate sizing and rounding of the ends. Tubing shall be cut squarely and all edge roughness shall be removed prior to flaring. All couplings shall be tightened securely, so the flared end fits snugly against the level of the fitting without leakage. The flared joint couplings shall be made up without the use of jointing compounds.

The service pipe and curb stop coupling depth shall be such as to maintain not less than the specified minimum cover, or in locations where conflict may occur with storm sewer, service pipe shall be placed at least 3 feet below the storm sewer invert or shall be insulated in accordance with the Plans, Specifications, and Special Provisions to prevent freezing. In any case the contractor shall make every effort to provide for a standard service box installation where practicable. The service box shall be centered over the curb stop coupling and be firmly supported on concrete blocking as required by the Plans, Specifications, and Special Provisions. Clearance shall be provided to the service box does not rest on the water pipe. Service

boxes shall be installed plumb and be traced effectively to remain vertical during and after completion of backfilling. The service boxes shall be brought to proper surface grade when the final ground surface has been established.

F Setting Valves, Hydrants, Fitting; and Specials

Valves, hydrants, fittings, and specials shall be provided and installed as required by the Plans, Specifications, and Special Provisions, with the exact locations and setting as directed by the Engineer, and with each installation accomplished in accordance with the requirements for installation of mainline pipe to the extent applicable. Support blocking, reaction backing, and anchorage devices shall be provided as required by the Plans, Specifications, and Special Provisions, or as otherwise ordered by the Engineer.

Hydrants shall be installed plumb, with the height and orientation of nozzles as shown in the Plans or as directed by the Engineer. Unless otherwise specified, the hydrants shall be connected to the mainline pipe with 6-inch diameter ductile iron branch pipe, controlled by an independent gate valve.

When a hydrant with an open drain outlet is set in clay or other imperious soil, a drainage pit of a least one cubic yard shall be excavated below and around the hydrant base and the pit shall be filled with Foundation Material to a level six inches above the drain outlet. Two layers of tar paper, or other material approved by the Engineer, shall be carefully placed over the rock to prevent backfill material from entering voids in the rock drain. Hydrants located where the groundwater table is above the drain outlet shall have the outlet plugged and shall be equipped with a tag stating, "Pump After Use".

Valve boxes shall be centered over the wrench nut of the valve and be installed plumb, with the box cover flush with the surface of the finished pavement or at such other level as may be directed. Valve boxes shall not be installed so as to transmit shock or stress to the valve.

Masonry valve pit structures, for valves with exposed gearing or operating mechanisms, shall be constructed in accordance with the details shown in the Plans and with the applicable provisions of Mn/DOT Specification 2506.

Drainage branches, blow-offs, air vents, and other special appurtenances shall be provided and installed as required by the Plans, Specifications, and Special Provisions.

Hydrostatic Testing of Water Mains

Each valved section shall be subjected to the pressure and leakage tests prescribed herein. The Contractor shall furnish the pump, pipe connections, gauges, and measuring equipment, and shall perform the testing under the direct observation of the engineer. Where permanent air vents are not provided, the contractor shall provide and install corporation stops at the high points as needed for release of air as the line is filled with water.

Where concrete reaction blocking is placed, the water main shall not be subjected to hydrostatic pressure until at least 5 days have elapsed after the concrete casting, with the exception that this period may be reduced to 2 days where high early strength concrete is used.

At the option of the Engineer, the pressure and leakage tests may be conducted simultaneously. Any defective joints, and any defective pipe, fittings, valves, or hydrants, revealed during the testing or before final acceptance of the work shall be satisfactorily corrected; and the tests shall be repeated until the specified requirements have been met.

Pressure Test

The section being tested shall be slowly filled with water to the specified test pressure shall be applied, after all air has been expelled from the pipe. A hydrostatic pressure of not less than 150 pounds per square inch, measured at the lowest point of elevation, shall be applied by means of a pump connected to the pipe in a satisfactory manner.

The specified pressure shall be held for a minimum duration of two hours. No drop in pressure will be allowed except as specified in the Special Provisions.

Service pipe may be tested at the time of the foregoing test, if installed, at the Contractor's option. However, testing service pipes may be completed as a separate operation from the testing, and if so, the test pressure shall be 100 p.s.f. twice pipe testing, if done separately, shall be done with the operation stop open.

Leakage Test

After satisfactory completion of the pressure test, a leakage test shall be performed on each valved section of watermain

to determine the quantity of water that must be supplied into the section to maintain a test pressure of 150 pounds per square inch, after the air in the pipeline has been expelled and the pipe has been filled with water.

After filling the pipe with water and expelling all air in the line, the specified pressure shall be applied in the same manner as prescribed for the pressure test, and sufficient water shall be measured and supplied into the pipe section to maintain the pressure for a test duration of 2 hours.

Each pipe section tested shall be accepted if the leakage does not exceed the quantity determined by the formula given below.

$$L = \frac{SD\sqrt{P}}{133200}$$

- L = Maximum permissible leakage in gallons per hour
- S = Length of pipe tested in feet
- D = Nominal diameter of pipe in inches
- P = Average test pressure during the test, in pounds per square inch, gauge pressure.

If the pipe section under test contains pipe of various diameters, the allowable leakage will be the sum of the computed leakage for each size of pipe.

When requested, the Contractor shall furnish a written report of the results of leakage tests, which shall identify the specific test section, the average pressure, the duration of test, and the amount of leakage.

Pipeline Backfilling Operations

All pipeline excavations shall be backfilled to restore pre-existing conditions as the minimum requirement, and fulfill all supplementary requirements indicated in the plans, Specifications, and Special Provisions. The backfilling operations shall be started as soon as conditions will permit on each section of pipeline, so as to provide continuity in subsequent operations and restore normal public service as soon as practicable on a section-by-section basis. All operations shall be pursued diligently, with proper and adequate equipment, as will assure acceptable results.

The backfilling shall be accomplished with the use of Suitable Materials selected from the excavated materials to the

Turf Restoration

Turf restoration shall be accomplished by sod placement except where seeding is specifically allowed or required.

Topsoil shall be placed to a minimum depth of four inches for all sodding and in all areas seeded. The topsoil material shall be light friable loam containing a liberal amount of humus and shall be free of heavy clay, coarse sand, stones, roots, sticks and other foreign matter. Topsoil meeting these requirements shall be selected from the excavated materials to the extent available and needed.

All turf establishment work shall be done in substantial compliance with the provisions of Mn/DOT Specification 2575. It shall be Mixture No. 1 of Mn/DOT Specification 3876, unless otherwise directed or approved.

Pavement Restoration

The in-place pavement structure (including base aggregates) shall be restored in kind and depth as previously existed, using base aggregates salvaged from the excavated materials to the extent available and needed, and with new materials being provided for reconstruction of the concrete or bituminous surface courses.

If, through no fault of the Contractor in failing to reserve sufficient aggregate materials from the excavations, there should be insufficient quantity of suitable aggregate to reconstruct the pavement base courses, the additional materials required will be furnished by the Owner at its expense, or the Contractor will be required to furnish the additional materials from outside sources as an Extra Work Item in the absence of an appropriate Contract item therefor. Placement of any additional aggregate materials delivered to the site by the Owner or of any additional materials furnished by the Contractor shall be an incidental expense, as shall also be the disposal of any excess materials resulting therefrom, unless special payment provisions are otherwise agreed upon.

Reconstruction of aggregate base courses and concrete or bituminous surface courses shall be in substantial compliance with all applicable Mn/DOT Specifications pertaining to the item being restored. The materials used shall be comparable to those used in the in-place structure, and the workmanship and finished quality shall be equal to that of new construction to the fullest extent obtainable in consideration of operational restrictions.

Existing concrete and bituminous surfaces at the trench wall shall be sawed or cut with a cutting wheel to form a neat edge in a straight line before surfaces are to be restored. Sawing or cutting may be accomplished as a part of the removal or prior to restoration at the option of the Contractor. However, all surface edges will be inspected prior to restoration.

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Restoration of Miscellaneous Items

Wherever any curbing, curb and gutter sections, pedestrian walks, fencing, driveway surfacing, or other improvements are removed or in any way damaged or undermined, they shall be restored to original condition by repair or replacement as the Engineer considers necessary. Replacement of old materials will be acceptable only to the extent that existing quality can be fully achieved, such as in the case of fencing. Otherwise new materials shall be provided and placed as the Engineer directs. Workmanship and finished quality shall be equal to that of new construction, where new materials are used, to the extent obtainable in consideration of operational restrictions.

A proper foundation shall be prepared before reconstructing concrete or bituminous improvements. Unless otherwise directed, granular material shall be placed to a depth of at least four inches under all concrete and bituminous items. No direct compaction will be made for furnishing and placing this material even though such course was not part of the original construction.

L Maintenance and Final Cleanup

All subgrade surfaces shall be maintained acceptably until the start of surfacing construction or restoration work, and until the work has been finally accepted. Additional materials shall be provided and placed as needed to compensate for trench settlement and to serve as temporary construction pending completion of the final surface improvements.

Final disposal of debris, waste materials, and other remains or consequences of construction, shall be accomplished intermittently as new construction items are completed and shall not be left to await final completion of all work. Cleanup operation shall be considered as being a part of the work covered under the Contract Items involved and only that work which cannot be accomplished at any early time shall be considered as final cleanup work not attributable to a specific Contract Item.

II Insulation

Main insulation shall be extruded rigid board material having a thermal conductivity of 0.23 BTU/hour/square foot/degree Fahrenheit/1/8 inch thickness, maximum, at 40°F mean, a compressive strength of 35 psi minimum, and water absorption of 0.25 percent by volume maximum.

Unless otherwise specified in the Plans, Specifications, and Special Provisions, board dimensions shall measure 8 feet long, 2 or 4 feet wide, and 1 or 1-1/2 inches thick.

2621.3 CONSTRUCTION REQUIREMENTS

A General Provisions

A1 Maintenance of Traffic

Whenever work interferes with the flow of traffic along a roadway, the Contractor shall provide for traffic control and signing and public safety in accordance with the provisions of Appendix B of the Missouri Manual of Uniform Traffic Control Devices and Mn/DOT Specifications 1404 and 1710, and the Special Provisions. Neither road closures nor detours shall be permitted unless specified in the Special Provisions or authorized by the Engineer. Where road closures or detours are permitted by the Engineer, the Engineer shall determine the appropriate agencies, boards, or departments the Contractor must notify prior to taking the action and the prior advance notice to be provided to each body.

Compliance with this requirement shall not be construed to relieve the Contractor from the responsibility of notifying agencies or institutions whose services may be predicated upon a roadway being opened to traffic or whose services would be hindered if a roadway is closed to traffic. Such agencies or institutions shall include, but not be limited to, the police department, the fire department, municipal bus service, school bus service, and ambulance service. The Contractor shall keep the required agencies informed of changing traffic patterns and detour situations.

A2 Establishing Line and Grade

In locations where the sewer is in direct conflict with existing watermain and water services the watermain and water services shall be located to provide at least 18 inches of vertical distance between the top of the watermain or service and

the bottom of the sanitary sewer or relocated in accordance with Plans.

When local conditions prevent a vertical separation as described, the following construction shall be used:

a vertical separation of at least 18 inches between the bottom of the sewer and the top of the watermain; adequate structural support for the sewer to prevent excessive deflection of joints and settling on and breaking of the watermain;

that the length of water pipe be centered at the point of crossing so that the joints will be equidistant and as far as possible from the sewer.

Watermain shall be laid at least 10 feet horizontally from any sanitary sewer, storm sewer or sewer manhole, whenever possible. When local conditions prevent a horizontal separation of 10 feet, a watermain may be laid closer to a storm or sanitary sewer provided that:

- (1) The bottom of the watermain is at least 18 inches above the top of the sewer;
- (2) Where this vertical separation cannot be obtained, the sewer shall be constructed of materials and with joints that are equivalent to watermain standards of construction and shall be pressure tested to assure water tightness prior to backfilling.

The primary line and grade will be established by the Engineer. For trench installation, line and grade stakes will be set parallel to the proposed pipeline at an appropriate distance therefrom as will best serve the Contractor's operations wherever practical. For tunnel installation, line and grade stakes will be set directly above the proposed pipeline setting. Grade and line stakes will be set at 25-foot intervals along the pipeline at each change in line or grade, and as needed for pipeline adjustments.

The Contractor shall arrange operations to avoid unnecessary interference with the establishment of the primary line and grade stakes, and shall render whatever assistance may be required by the Engineer in accomplishing the staking. The Contractor shall be responsible for preservation of the primary stakes, and, if negligent in providing necessary protection, shall bear the full cost of any restaking.

red along the break line; to a minimum depth of one-third of structure depth.

Any reusable material generated during the work, such as regate, sod, or topsoil, shall be segregated from other waste materials and be stockpiled so as to maintain suitability and permit proper reuse.

The use of drop weight equipment for breaking pavement will be allowed to the extent that the Contractor shall assume full responsibility for any damages caused thereby. The pavement breaking operations shall not be allowed to become a nuisance to the public or a source of damage to underground or adjacent structures. The Engineer reserves the right to order discontinuance of drop weight breaking operations at any time.

Temporary Service Measures

While any open excavations are maintained, the Contractor will have available a supply of steel plates suitable for temporary bridging of open trench sections where either vehicular or pedestrian traffic must be maintained. Use of the plates shall be as directed or approved by the Engineer and where installed they shall be secured against possible displacement and be replaced with the permanent structure as soon as possible.

Excavation and Preparation of Trench

Operational Limitations and Requirements

Excavating operations shall proceed only so far in advance of pipe laying as will satisfy the needs for coordination of work and permit advance verification of unobstructed line and grade as planned. Where interference with existing structures is possible in any way indicated, and where necessary to establish elevation or direction for connections to in-place structures, the excavating shall be done at those locations in advance of the in operation so actual conditions will be exposed in sufficient time to make adjustments without resorting to extra work or necessary delay.

All installations shall be accomplished by open trench construction except for short tunnel sections approved by the Engineer and with the exception that boring and jacking or tunnel construction methods shall be employed where so specifically required by the Plans, Specifications, or Special Provisions. Installation of pipe through tunnel excavations will be allowed

only where the surface structure can be properly supported and the backfill restored to the satisfaction of the Engineer.

The excavating operations shall be conducted so as to carefully expose all in-place underground structures without damage. Wherever the excavation extends under or approaches so close to an existing structure as to endanger it in any way, precautions and protective measures shall be taken as necessary to preserve the structure and provide temporary support. Hand methods of excavating shall be utilized to probe for and expose such critical or hazardous installations as gas pipe and power or communication cables.

The Engineer shall be notified of any need for blasting to remove materials which cannot be broken up, mechanically, and there shall be no blasting operations conducted until the Engineer's approval has been secured. Blasting will be allowed only when proper precautions are taken to protect life and property, and then shall be restricted as the Engineer directs. The Contractor shall assume full responsibility for any damages caused by blasting, regardless of the requirements or notification and approval. The Contractor shall secure any required permits for blasting and shall conduct blasting operations in conformance with all applicable state and local laws, regulations and ordinances.

B2 Classification and Disposition of Materials

Excavated materials will be classified for payment only to the extent that the removal of materials classified by the Engineer as Rock will be paid for separately from other unclassified materials, either as a separate Contract Item or as an Extra Work Item when no bid price is applicable. All other materials encountered in the excavations, with the exception of items classified for payment as structure removals will be considered as Unclassified Excavation, and unless otherwise specified in the Plans, Specifications, and Special Provisions, no additional compensation shall be provided for their removal. Unclassified materials shall include muck, rubble, wood debris, and boulder stone, masonry or concrete fragments less than one cubic yard in volume, together with other miscellaneous matter that can be removed effectively with power operated excavators without resorting to drilling and blasting.

Rock excavation shall be defined to include all hard, solid rock in ledge formation, bedded deposits and stratified masses; all natural conglomerate deposits so firmly cemented as to present all the characteristics of solid rock; and any boulder

used by settlement, water or earth pressures, slides, cave-ins, or other causes due to failure or lack of sheeting, shoring, or bracing or through negligence or fault of the Contractor in any manner shall be repaired at the Contractor's expense and without delay.

Where conditions warrant extreme care, the Plans, Specifications, and Special Provisions may require special precautions to protect life or property, or the Engineer may order the installation of sheet piling of the interlocking type direct that other safety measures be taken as deemed necessary. Failure of the Engineer to order correction of proper or inadequate sheeting, shoring, or bracing shall not relieve the Contractor's responsibilities for protection of life, property, and the work.

The Contractor shall assume full responsibility for proper and adequate placement of sheeting, shoring, and bracing, however and to such depths that soil stability may dictate the need for support to prevent displacement. Bracing shall be so arranged as to provide ample working space and so as not to place stress or strain on the in place structures to any extent that may cause damage.

Sheeting, shoring and bracing materials shall be removed only when and in such manner as will assure adequate protection of the in place structures and prevent displacement of supported loads. Sheeting and bracing shall be left in place only as required by the Plans, Specifications, and Special Provisions or ordered by the Engineer. Otherwise, sheeting and bracing may be removed as the backfilling reaches the level of respective support. Wherever sheeting and bracing is left in place, the upper portions shall be cut and removed to an elevation of three feet or more below the established surface grade as the Engineer may direct.

All costs of furnishing, placing, and removing sheeting, shoring, and bracing materials, including the value of materials left in place as required by the Contract, shall be included in the prices bid for pipe installation and will not be compensated separately. When any sheeting, shoring, or bracing materials are left in place by written order of the Engineer, in the absence of specific requirements of the Contract to do so, payment will be made for those materials as an Extra Work Item, including waste material resulting from upper cut-off requirements.

B5

Preparation and Maintenance of Four Stations

Foundation preparations shall be conducted as necessary to produce a stable foundation and provide continuous and uniform pipe bearing between bell holes. The initial excavating or backfilling operations shall produce a subgrade level slightly above finished grade as will permit hand shaping to finished grade by trimming of high spots and without the need for filling of low spots to grade. Final subgrade preparations shall be such as to produce a finished grade at the centerline of the pipe that is within 0.03 foot of a straight line between pipe joints and to provide bell hole excavation at each joint as will permit proper joining of pipe and fittings.

In excavations made below grade to remove rock or unstable materials, the backfilling to grade shall be made with available suitable materials unless placement of Granular Foundation or Bedding material is specified and provided for or is ordered by the Engineer as an Extra Work Item. Placement of the backfill shall be in relatively uniform layers not exceeding 8 inches in loose thickness. Each layer of backfill shall be compacted thoroughly, by means of approved mechanical compaction equipment, as will produce uniform pipe support throughout the full pipe length and facilitate proper shaping of the pipe bed.

Where the foundation soil is found to consist of materials that the Engineer considers to be so unstable as to preclude removal and replacement to a reasonable depth to achieve solid support, a suitable foundation shall be constructed as the Engineer directs in the absence of special requirements therefor in the Plans, Specifications, and Special Provisions. The Contractor may be required to furnish and drive piling and construct concrete or timber bearing supports or other work as may be provided for in an Extra Work order.

Care shall be taken during final subgrade shaping to prevent any over-excavation. Should any low spots develop, they shall only be filled with approved material, which shall have optimum moisture content and be compacted thoroughly, without additional compensation provided to the Contractor. The finished subgrade shall be maintained free of water and shall not be disturbed during pipe lowering operations except as necessary to remove pipe slings. The discharge of trench dewatering pumps shall be directed to natural drainage channels or storm water drains. Draining trench water into sanitary sewers or combined sewers will not be permitted.

oroughly compacted by tamping around the pipe to a height of at least 12 inches above the top with hand operated mechanical tamping devices or by hand. The joint areas shall remain exposed and precautions shall be taken to prevent the soil from entering the joint space, until the joint seal is effected. Backfill in the bell area shall be left loose.

Connection of pipe to existing lines or previously constructed manholes or catch basins shall be accomplished as shown in the Plans or as otherwise approved by the Engineer. Where necessary to make satisfactory closure or produce the required curvature, grade or alignment deflections at joints shall not exceed that which will ensure tight joints and comply with any limitations recommended by the pipe manufacturer.

Entrance of foreign matter into pipeline openings shall be prevented at all times to the extent that suitable plugs or covering can be kept in place over the openings without interfering with the installation operations.

Installation of PVC, ABS, and composite truss pipe shall conform to ASTM D-2321.

3 Connection and Assembly of Joints

All pipe and fitting joints shall fit tightly and be fully loused. Spigot ends shall be marked as necessary to indicate the point of complete closure. All joints shall be solid tight, as the minimum requirement, and shall be watertight in all sanitary sewer pipe lines and in all storm sewer pipe lines installed within the limits of a paved street or highway traffic lanes. Where specified, the joints in certain assemblies shall be made structurally integral by being completely encased in concrete to form a rigid watertight unit as indicated in the standard drawings.

Where watertight joints are required, without concrete encasement, the joints shall be sealed as follows, subject to such other approved method as the Engineer may authorize as being an acceptable alternative:

- (1) Concrete pipe and fitting joints - compression type rubber gasket seals conforming to the requirements of ASTM C-443, ASTM C-361 or ASTM M-198 for circular pipe, or as otherwise approved by the Engineer in the case of non-circular pipe sections.

- (2) ABS/PVC Truss pipe, ABS solid wall pipe and fittings - assembled gasket seal joints.

- (3) Smooth wall and corrugated wall PVC pipe and fittings - assembled push-on gasketed joints shall pass performance tests as listed in ASTM D-3212. Solvent welds shall not be permitted.

- (4) Vitrified clay pipe and fittings - factory fabricated compression seals or compression type couplings.

- (5) Corrugated steel pipe and fittings - sealed with approved type compression seals.

Where watertight joints are not required joints in concrete pipe shall be made solid tight by filling with mortar as the Engineer directs. Pipe joints encased in concrete will not have to be sealed with gasket type seals but shall be filled with mortar as directed.

C4 Bulkheading Open Pipe Ends

All pipe and fitting ends left open for future connection shall be bulkheaded by approved methods prior to backfilling. Unless otherwise specified or approved, all openings of 24 inches in diameter or less shall be closed off with prefabricated plugs or caps and all openings larger than 24 inches in diameter shall be closed off with masonry bulkheads.

Prefabricated plugs and caps shall be of the same material as the pipe material, or an approved alternate material, and they shall be installed with watertight seals as required for the pipeline joints. Masonry bulkheads shall be constructed with clay or concrete brick to a wall thickness of eight inches.

Bulkheads installed for temporary service during construction may be constructed with two-inch timber planking securely fastened together and adequately braced, as an alternate to the masonry construction.

C5 Placement of Insulation

Rigid insulation board shall be placed within the pipe encasement zone, 6 inches above the pipe. Prior to placement of the insulation, encasement material shall be compacted until there is no further visual evidence of increased consolidation or the density of the compacted layer conforms to the density requirements specified in the Special Provisions, then leveled

Unless otherwise indicated, service pipe installation shall terminate at property line or as designated on the Plans, with a gasketed plug placed in the end, at which point the Contractor shall furnish and set a 4 x 4 inch wooden timber 6 feet to 8 feet in length embedded 4 feet below grade, or approved steel post, to mark the exact end of pipe. The timber or post shall be set vertically, with the top 2 feet painted green.

Wherever service line connections to the main sewer are permitted or required to be made by the open cut-out method in the absence of a built-in Tee or Wye fitting, the connection shall be made by using an approved type of Saddle Tee fitting. The pipe cut-out shall be made with an approved type coring machine or by other approved methods producing a uniform, smooth circular cut-out as required for proper fit. The cut-out discs shall be retrieved and shall not be allowed to remain within the main sewer pipe. The Saddle Tee shall be securely fastened to the main sewer pipe by means of epoxy resin or other approved adhesive. The entire connection fitting shall be encased in concrete to a minimum thickness of six inches and as may be shown in the standard drawings.

Wherever service line connections to the main sewer are required to be made by means of built-in Branch Tee or Wye fittings, the Contractor shall, in the absence of such fitting, remove a section of the main sewer pipe and replace it with the required Branch Tee or Wye section connected by means of an approved sleeve coupling.

Sanitary sewer service lines shall not be connected to a manhole at an elevation more than 24 inches above the crown of the outgoing sewer. Where the elevation difference is greater than 24 inches, the connection shall be made by means of an Outside Drop Connection in accordance with the details shown in the standard drawings.

All pipe and fitting openings at temporary terminal points shall be fitted with suitable plugs or shall be bulkheaded as required for the main sewer pipe.

F Manhole and Catch Basin Structures

Manholes, catch basins, and other special access structures shall be constructed at designated locations as required by the Plans and in accordance with any standard detail drawings or special design requirements given therefor.

Unless otherwise specified or approved, manholes and catch basins shall be constructed on a cast-in-place concrete base and the barrel riser sections, cone section and top adjusting rings shall all be of precast concrete. All units shall be properly fitted and sealed to form a completely watertight structure. Barrel and cone height shall be such as to permit placement of at least three and not more than six standard two-inch precast concrete adjusting rings immediately below the casting assembly which shall be set in a mortar bed. Each adjusting ring shall also be set in mortar.

Unless otherwise specified or approved, manholes and catch basins shall have an inside barrel diameter at the bottom of 48 inches minimum and the inside diameter at the top of the cone section and of all adjusting rings shall be of the same size and shape as the casting frame. Casting assemblies shall be as specified in the Plans. Catch basin grade elevation shall be adjusted as necessary to maintain the required dip below normal gutter grade.

The concrete cast-in-place base shall be poured on undisturbed or firmly compacted foundation material which shall be trimmed to proper elevation. The bottom riser section shall be set in fresh concrete or mortar and all other riser section joints of the tongue and groove design shall be sealed with rubber gaskets.

Wherever special designs so require or permit, and as otherwise may be approved by the Engineer, a pre-cast concrete base may be used or the structure may be constructed with solid sewer brick or block units or with cast-in-place concrete. Any combination of cast-in-place concrete and brick or block mortar construction will be allowed and may be required where it is impossible to complete the construction with standard precast manhole sections.

All annular wall space surrounding the in-place storm sewer pipes shall be completely filled with mortar or concrete, and the inside bottom of each manhole and catch basin shall be shaped with fresh concrete to form free flow through invert troughs as directed.

Sanitary sewer main lines shall not be connected to a manhole at an elevation more than 24 inches above the invert of the outgoing sewer. Where the elevation difference is greater than 24 inches, the connections shall be made by means of an Outside Drop Connection in accordance with the detailed drawings in the Plans. The concrete base under the drop connection shall be monolithic with the manhole base.

I Pipeline Backfilling Operations

All pipeline excavations shall be backfilled to restore pre-existing conditions as the minimum requirement, and fulfill all supplementary requirements indicated in the Plans and Specifications, and Special Provisions. The backfilling operations shall be started as soon as conditions will permit on each section of pipeline, so as to provide continuity in subsequent operations and restore normal public service as soon as practicable on a section-by-section basis. All operations shall be pursued diligently, with proper and adequate equipment, as will assure acceptable results.

The backfilling shall be accomplished with the use of Suitable Materials selected from the excavated materials to the extent available and practical. Should the materials available within the trench section be unsuitable or insufficient, without loading and hauling or the employment of unreasonable measures, the required additional materials shall be furnished from outside sources as an Extra Work Item in the absence of any Special Provision requirements.

Suitable Material shall be defined as a mineral soil free of foreign materials (lubbish, debris, etc.), frozen clumps, oversize stone, rock, concrete or bituminous chunks, and other unsuitable materials, that may damage the pipe installation, prevent thorough compaction, or increase the risks of after settlement unnecessarily. Material selection shall be such as to make the best and fullest utilization of what is available, taking into consideration particular needs of different backfill zones. Material containing stone, rock, or chunks of any sort shall only be utilized where and to the extent there will be no detrimental effects.

Within the pipe bedding and encasement zones described as that portion of the trench which is below an elevation one foot above the top of the pipe, the materials placed shall be limited in particle size to $1\frac{1}{2}$ inches maximum in the case of pipe of 12 inches in diameter or less and to 2 inches maximum in the case of larger pipe. Above these zones, the placement of material containing stones, boulders, chunks, etc. greater than 8 inches in any dimension shall not be allowed.

Compaction of materials placed within the pipe bedding and encasement zones shall be accomplished with portable or hand equipment methods, so as to achieve thorough consolidation under and around the pipe and avoid damage to the pipe. Above the

cover zone material, the use of heavy roller type compaction equipment shall be limited to safe pipe loading.

Backfill materials shall be carefully placed in uniform loose thickness layers of 8 inches spread over the full width and length of the trench section to provide simultaneous support on both sides of the pipeline. Granular backfill may be placed in 12 inch layers above an elevation one foot above the top of the pipe, and with the provision that, by authority and at the discretion of the Engineer in consideration of the demonstrated capability of special type vibrating compactors, the stated maximums may be increased.

Each layer of backfill material shall be compacted effectively, by approved mechanical or hand methods, until there is no further visual evidence of increased consolidation or the density of the compacted layer conforms to the density requirements specified in the Special Provisions. Compaction of the in-place layer shall be completed acceptably before placing material for a succeeding layer thereon. The manner of placement, compaction equipment and procedure effectiveness shall be subject to approval of the Engineer.

All surplus waste materials remaining after completion of the backfilling operations shall be disposed of in an acceptable manner within 24 hours after completing the backfill work on each particular pipeline section. Disposal at any location within the project limits shall be as specified, or as approved by the Engineer; otherwise, disposal shall be accomplished outside the project limits at the Contractor's discretion. The backfilling and surplus or waste disposal operations shall be a part of the work required under the pipeline installation items, not as work that may be delayed until final cleanup.

Until expiration of the guarantee period, the Contractor shall assume full responsibility and expense for all backfill settlement and shall refill and restore the work as directed to maintain an acceptable surface condition, regardless of location. All additional materials required shall be furnished without additional cost to the Owner.

Restoration of Surface Improvements

Whenever any surface improvements such as pavement, curbing, pedestrian walks, fencing, or turfing have been removed, damaged or otherwise disturbed by the Contractor's operations, they shall be repaired or replaced to the Engineer's satisfaction, as will restore the improvement in kind and structure to the preexisting

until the work has been finally accepted. Additional materials shall be provided and placed as needed to compensate for trench settlement and to serve as temporary construction pending completion of the final surface improvements.

Final disposal of debris, waste materials, and other remains or consequences of construction, shall be accomplished intermittently as new construction items are completed and shall not be left to await final completion of all work. Cleanup operations shall be considered as being a part of the work covered under the Contract item involved and only that work which cannot be accomplished at any early time shall be considered as final cleanup work not attributable to a specific Contract item.

If disposal operations and other cleanup work are not conducted properly as the construction progresses, the Engineer may withhold partial payments until such work is satisfactorily pursued or he may deduct the estimated cost of its performance from the partial estimate value.

Maintenance of scolded and seeded areas shall include adequate watering for plant growth and the replacement of any dead or damaged sod as may be required for acceptance of the work.

L. Deflection Test

Deflection tests shall be performed on all plastic gravity sewer pipes. The test shall be conducted after the sewer trench has been backfilled to the desired finished grade and has been in place for 30 days.

The deflection test shall be performed by pulling a rigid ball or pointed mandrel through the pipe without the aid of mechanical pulling devices. The ball or mandrel shall have a minimum diameter equal to 95% of the actual inside diameter of the pipe. The maximum allowable deflection shall not exceed five percent of the pipe's internal diameter. The time of the test, method of testing, and the equipment to be used for the test shall be subject to the approval of the Engineer.

All testing shall be performed by the Contractor at his expense without any direct compensation being made therefor, and he shall furnish all necessary equipment and materials required.

L1 Test Failure and Remedy

In the event of test failure on any test section, the section shall be replaced, with all repair work subject to

approval of the Engineer. The replaced section shall be retested for leakage and deflection in conformance with the specifications contained herein. All repairs, replacement, and retesting shall be at the Contractor's expense.

M Televising

Sewer line televising may be required by the Engineer, at the cost of the Contractor, if visual inspection, leakage testing, or deflection testing indicate the sewer has not been constructed in accordance with these specifications and the requirements of the Plans, Specifications, and Special Provisions.

2621.4 METHOD OF MEASUREMENT

All items will be measured separately according to design designation as indicated in the Pay Item name and as may be detailed and defined in the Plans, Specifications, or Special Provisions. Pipe will generally be designated by size (inside diameter or span), strength class, kind or type, and laying condition. Complete-in-place items shall include all component parts thereof as described or required to complete the unit, but excluding any excesses covered by separate Pay Items. Linear measurement of piping will include the running length of any special fittings (tees, wyes, elbows, gates, etc.) installed within the line of measure between specific terminal points.

A Sewer Pipe

Sewer pipe of each design designation will be measured by length in linear feet along the line of pipe. Terminal points of measurement will be the pipe end at free outlets; the point of connection with in-place pipe; the center of manholes or catch basins; the point of centerline intersection at branch fittings; or the point of juncture with other appurtenances or units as defined.

Separation of quantities according to "depth zone classification", when so designated in the Pay Item, will be determined by depth of pipe invert below the ground surface profile.

B Manholes

Manholes of each design designation will be measured by number of each constructed complete-in-place, including the base and castings as required, but excluding any excess depth greater than 8.0 feet measured from top of manhole cover to invert elevation of lowest pipe.

not extend beyond the existing ditch bottoms, and the improvement does not remove more than 20 percent of the length of the existing bituminous or concrete surfacing over the length of the project.

Selected improvements must improve roadway design elements where accidents or other safety problems can be documented, or where benefits are clearly supported by an economic analysis. Written justification for these selected improvements must be submitted to the state-aid engineer for concurrence before the plan is approved. The state-aid engineer's concurrence must be based on the applicable criteria of part 8820.1100, subparts 1 and 1a. Resurfacing projects may include spot subgrade corrections over a small percentage of the project length without written justification.

In addition to the standards in subpart 1, the slopes must be 1:3 or flatter and must be free of obstacles to at least three meters from the edge of the driving lane or to the toe of the inslope.

SA: MS 5 167.02; 167.09
HIST: 20 SR 1041

8820.9930 (Repealed, 20 SR 1041)

8820.9931 GEOMETRIC DESIGN STANDARDS: SUBURBAN; NEW OR RECONSTRUCTION.

Projected AOT	Lane Width (meters)	Shoulder Width (meters)	Slopes (a) (flattest)	Barney Rise (b) (steepest)	Design Speed (c) (km/h)	Structural Depth to Subgrade (meters)	Width to Lane (d) (meters)
Less than 1000	3.6	1.8	1:4	3	50-80	0.2	8.4
Over 1000	3.6	2.4	1:4	6(e)	50-80	0.2	9.0

- (a) Applies to slope within the recovery area only.
Approach sidewalks must be 1:4 or flatter.
(b) Obstacle-free area, measured from edge of traffic lane. Culverts with less than 875-millimeter vertical height allowed without protection in the recovery area.

Guardrail is required to be installed at all bridges where the design speed exceeds 60 kilometers per hour, and either the ADR exceeds 400 or the bridge width is less than the sum of the lane and shoulder widths.

Mailbox supports must be in accordance with the provisions of chapter 8818.

(c) Subject to terrain.
(d) Inventory design rating M 13.5. Bridges narrower than these widths may remain in place provided that the bridge does not qualify for federal-aid bridge funds.

(e) Where the posted speed limit is 60 kilometers per hour or less, the minimum recovery area may be reduced to three meters.

This standard applies only when the project is both located in a subdivided area or an area in a detailed development process, and physical restraints are present that prevent reasonable application of the rural design standards. This standard may also be applied when the legal speed limit is 60 kilometers per hour or less.

MS 22.5 loading or LRFD design is required for new bridges. MS 16 loading is required for all rehabilitated bridges. The curb-to-curb minimum width for new or rehabilitated bridges is the sum of the lane and shoulder widths plus 1.2 meters.

SA: MS 5 167.02; 167.09
HIST: 20 SR 1041

8820.9935 (Repealed, 20 SR 1041)

8820.9936 GEOMETRIC DESIGN STANDARDS, URBAN; NEW OR RECONSTRUCTION.

Functional Classification and Projected Traffic Volume	Design Speed (km/h)	Lane Width (meters)	Curb-to-Curb Minimum Width (meters)	Design Lane Width (meters)
Collectors or Locals with AOT < 10000+	50-60 km/h	3.3 (b)	0.6	2.4
Collectors or Locals with AOT 2 10000	over 60 km/h	3.6	0.6	3.0
Collectors or Locals with AOT 2 10000 and Arterials	50-60 km/h	3.3 (b)	1.2 (c)	3.0
	over 60 km/h	3.6	1.2 (c)	3.0 (d)

- (a) One-way turn lanes must be at least three meters wide,