**CITY OF BRANSON**

# TECHNICAL SPECIFICATIONS

## FOR PUBLIC IMPROVEMENT PROJECTS

**March 2024**

**PUBLIC WORKS/ENGINEERING DEPARTMENT**
**110 West Maddux, Suite 310**
**Branson, Missouri 65616**
**(417) 337-8559**

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GENERAL PROVISIONS

The provisions in this section shall be considered as applicable to all parts of these specifications including all revisions or supplements.

A. DEFINITIONS. Whenever the following words, phrases, or abbreviations appear in these specifications, they shall have the following meanings:

1. Calendar Day is every day shown on the calendar and shall mean a day of 24 hours measured from midnight to the next midnight.

2. City shall mean the City of Branson, Missouri, a municipal corporation, acting by and through its duly elected governing body and its duly appointed officials.

3. Construction Easement shall mean the land provided temporarily by the City for use by the Contractor during the construction of the work.

4. Contractor shall mean the individual, firm, partnership, joint venture, corporation, or association contracting with the City, or private owner, to perform the work.

5. Design Engineer shall mean a licensed engineer under contract to the developer or the City of Branson for the purpose of preparing and sealing engineering design drawings for a specific public improvement project.

6. Engineer shall mean the Director of Public Works/Engineering of the City of Branson or his authorized representatives acting on behalf of the City.

7. Extra Work is work over and above that called for in the Contract.

8. Inspector shall mean an authorized representative of the Director of Public Works/Engineering who has been assigned to assure conformance to the requirements of specifications by the contractor.

9. Land, Right-of-Way, or Easement shall mean the land provided by the City upon which to construct the work.

10. Or Equal. To establish a basis of quality for items of the work, certain processes, equipment, proprietary products or materials and their manufacturer may be mentioned by name. Such mention is not intended to exclude other processes, equipment, proprietary products or materials and their manufacturers, provided they are proven by the Contractor, to the satisfaction of the Engineer, to be equal in quality and performance to the same specified prior to their inclusion in the work.

11. Performance Bond or Performance and Maintenance Bond shall mean the approved form of security furnished by the Contractor and his surety.

12. Permit shall mean the official document issued by the City, authorizing the construction of an improvement, subject to City inspection, control and approval.

13. Plans shall mean the official drawings, standard plans, profiles, and typical cross sections all as specified in the Special Provisions and supplemental drawings or reproduction thereof, approved and furnished by the Engineer which show the location, character, dimensions and details of the work. All such plans are to be considered as a part of the contract whether attached or separate.

14. Private Owner, or Developer shall mean the individual, corporation, partnership, joint venture, association or other legal entities paying all costs associated with the construction of an improvement under a permit granted by the City. Standard Specifications shall mean the official standard specifications, as adopted by the City.

15. Sub-Contractor is any individual, firm, partnership, corporation, or association licensed or otherwise authorized by law to do business in Missouri, to whom the Contractor, with written consent of the City, sublets a part of the work.

16. Surety shall mean the corporation, partnership or individual, duly licensed and authorized to do business in Missouri, who is bound with and for the Contractor to assume legal liability for the faithful performance of the contract.

17. Work or the Work shall mean the furnishing of all labor, materials, equipment and other incidentals necessary for the successful completion and the carrying out of all duties and obligations imposed by the contract or permit.

Whenever the words "as directed", "as required", "as permitted", or words of like meaning are utilized it shall be understood that the directions, requirements, or permission of the Engineer is intended. Similarly, the words, "approved", "acceptable", and "satisfactory" shall refer to approval of the Engineer.

B. REFERENCED STANDARDS. Whenever references are made to standard specifications, methods of testing, materials codes, practices, and requirements it shall be understood that the latest revisions of said references shall govern unless a specific revision is stated. Wherever any of the following abbreviations appear they shall have the following meaning:

A.A.S.H.T.O. - American Association of State Highway Transportation Officials
A.C.I. - American Concrete Institute
A.I.S.C. - American Institute of Steel Construction
A.W.S. - American Welding Society
A.P.W.A. - American Public Works Association
A.R.E.A. - American Railway Engineering Association
A.S.A. - American Standards Association
A.S.T.M. - American Society for Testing and Materials
A.N.S.I. - American National Standard Institute
A.W.W.A. - American Water Works Association

C.R.S.I. - Concrete Reinforcing Steel Institute
M.C.I.B. - Mid-West Concrete Industry Board, Inc.
W.P.C.F. - Water Pollution Control Federation
M.U.T.C.D. - Manual of Uniform Traffic Control Devices

Where the words "these specifications" appear or words of similar connotation are used it shall be understood that such reference refers to the "Technical Specifications for Public Improvement Projects" of the City of Branson.

C. PERMIT FOR CONSTRUCTION. No construction of any public improvement project shall be undertaken until the following criteria and requirements have been fully met unless otherwise allowed by the Engineer.

1. Contract plans and specifications have been submitted to and approved by the Engineer.

2. A suitable performance and maintenance bond submitted and approved by the Engineer and placed on file with the City.

3. Payment to the City of an amount equal to the following for each type of public improvement project.
Water lines - Four (4) percent of the total estimated cost of the project.
Sewers - Two (2) percent of the total estimated cost of the project.
Streets - Three (3) percent of the total estimated cost of the project.

Such payment shall only be required in connection with private developer projects and shall be payable to the Director of Finance.

4. Advance notification of a minimum five (5) working days from the contractor prior to actual start of work.

Compliance with the above shall constitute a permit for construction activities. Work discovered underway not complying with these requirements shall be ordered to cease and shall not be allowed to commence until such requirements have been met.

D. AUTHORITY OF THE ENGINEER. The director of public works/engineering is designated by the City of Branson to exercise all authority on behalf of the City to ascertain that all construction of facilities is equal to or better than the minimum construction requirements set forth in these specifications. The Engineer shall be represented by a project inspector to check any and all work performed, including all materials to be incorporated in the work, and all construction methods and practices. The Engineer shall have the sole authority to issue in writing any deviations from the provisions of these specifications or changes to any previously approved drawing.

OBSERVATION OF THE WORK.

1. General:

a. All materials and workmanship shall be subject to observation, examination, or test by the City of Branson and the Engineer or his representative at any and all times during construction and at any and all places where such construction is carried out. The City of Branson shall have the authority to reject defective material and workmanship or require its correction. Unacceptable workmanship shall be satisfactorily corrected. Rejected material shall be promptly segregated and removed from the project area and replaced with material of the specified quality to the satisfaction of the Engineer. If the contractor fails to proceed at once with correction of rejected workmanship or defective material, the City of Branson may contract or otherwise have the defects remedied or rejected materials removed from the project area and charge the cost of the same against the contractor, without prejudice to any other rights or remedies of the City of Branson.

b. The contractor shall furnish promptly all materials reasonably necessary for any test which may be required. All tests by the City of Branson will be performed in such manner as not to delay the work unnecessarily and will be made in accordance with the provisions of the Technical Specifications.

c. The contractor shall notify the City of Branson sufficiently in advance of backfilling or concealing any facilities to permit proper observation. If any facilities are concealed without approval or consent of the City of Branson, the contractor shall uncover for observation and recover such facilities all at his own expense, when so requested by the City of Branson.

d. Neither observing, testing, approval nor acceptance, of the work, in whole or in part, by the City of Branson or its agents shall relieve the contractor or his sureties of full responsibility for materials furnished, or work performed not in strict accordance with the specifications.

e. Any change or deviation from the approved plans and specifications approved by the Engineer must be received by the project manager in writing prior to implementing the change. The project managers are not authorized to alter any provisions or to issue instructions contrary to these specifications, or to make any revisions to any previously approved drawing.

2. Defective Work:

a. The term "defective" is used in these documents to describe work that is unsatisfactory, faulty, not in conformance with the requirements of the specifications, or not meeting the requirements of any observation, test, approval, or acceptance required by law or the specifications.

b. Any defective work may be disapproved or rejected by the City at any time before final acceptance even though it may have been overlooked and/or included in a previous pay estimate.

c. Contractor shall furnish samples of questionable equipment or materials from completed work for testing purposes when required by the Engineer. All costs in connection with the testing of equipment and materials which prove to be defective shall be paid by the contractor.

3. Uncovering Work:

a. If any work is covered without the concurrence of the inspector it must, if requested by the inspector, be uncovered for his observation. Such work will be at the contractor's expense unless the contractor has given the inspector timely notice, and the inspector has not acted within a reasonable time.
b. Should it be considered necessary or advisable by the City of Branson, at any time before final acceptance of the entire work to make an examination of work already completed by uncovering the same, the contractor shall on request promptly furnish all necessary facilities, labor, and material. If such work is found to be defective in any important or essential respect, due to the fault of the contractor or his subcontractors, the contractor shall defray all the expenses of such examination and of satisfactory reconstruction. If, however, such work is found to meet the requirements of the specifications, the actual cost of labor and materials necessarily involved in the examination and replacement, plus 15 percent of such cost to cover superintendence, general expenses and profit, shall be allowed the contractor and he shall, in addition, if completion of the work of the entire contract has been delayed thereby, be granted a suitable extension of time on account of the additional work involved.

E. WEEKEND OR HOLIDAY WORK. Work on Saturdays or legal holidays shall be as approved by the Engineer. Such approval shall be granted only upon advance notification of a minimum five (5) working days prior to the anticipated date of the work to be performed. Sunday work will not be allowed under any circumstance. Legal holidays observed by the City of Branson are New Year's Day, Martin Luther King Day, President's Day, Memorial Day, Emancipation Day (Juneteenth), Independence Day, Labor Day, Veterans Day, Thanksgiving Day, Day after Thanksgiving, and Christmas Day and Day after Christmas. The actual days off for these holidays may vary and in certain situations additional days may be a part of the amount of time granted as an official holiday by the City of Branson. It shall be the contractor's responsibility to obtain these days prior to the actual request for inspection services.

F. BONDS. A suitable performance and maintenance bond shall be furnished to the City of Branson guaranteeing the proper completion and maintenance of the construction involved in the public improvement project. The performance bond shall be in an amount equivalent to the full cost of the improvement. The maintenance bond shall remain in effect for a period of two (2) years for all public improvement projects and shall be in the amount of the full cost of the improvement.

No project shall be accepted by the City prior to the submittal and acceptance of the maintenance bond by the Engineer.

G. CHANGES IN THE WORK. Changes in the work from the approved project plans shall be made only upon the written consent of the Engineer. All proposed changes must be submitted to the Engineer (by the design engineer) to receive written approval by the City. Said written approval shall be received by the inspector prior to implementing the deviation. Any change in the work made without the consent of the Engineer shall be subject to removal by the contractor at his expense.

H. CORRELATION AND INTENT OF DOCUMENT. The plans and specifications are intended to supplement each other. Any work shown on the Plans and not mentioned in the Specifications (or vice versa) shall be as binding and shall be completed the same as if mentioned or shown on both. In case of conflict between the Plans and Specifications, the order of precedence shall be:

| | |
|---|---|
| First | Special Provision |
| Second | Detail Plans |
| Third | Standard Plans |
| Fourth | Standard specifications |

The general character of the detailed work is shown on the plans, but minor modifications may be made to the full size or scale details. Where the word "Similar" occurs on the plans, it shall be used in its general sense and not as meaning identical, and all details shall be worked out in relation to their location and their connection to the other parts of the work. Where on any plans, a portion of the work is drawn out and the remainder is indicated in the outline, the parts drawn out shall apply also to all other like portions of the work. Where ornaments or other details are indicated by starting only, such details shall be continued throughout the courses or parts in which they occur and shall also apply to all other similar parts in the work, unless otherwise indicated. In case of differences between small-and large-scale drawings, the larger scale drawings shall govern.

I. ERRORS AND OMISSIONS. The contractor shall check over the plans before beginning construction work, and if errors or omissions are discovered, he shall call them to the attention of the Engineer before proceeding with the work. In no case will the Contractor make corrections therefore without first consulting the Engineer. In case revised plans of a supplementary or explanatory nature are necessary or desirable for clarification or to correct any errors or omissions, they will be furnished by the Engineer or Design Engineer as required.

J. TRAFFIC CONTROL. The flow of traffic in the street and access to private property shall be reasonably always maintained. The contractor shall provide a safe roadway, and shall erect and maintain warning signs, barricades and sufficient safeguards around all excavations, embankments, and obstructions. The contractor shall provide suitable warning lights or flares and shall keep them lit from one-half hour prior to sunset until one-half hour after sunrise and all other times when visibility is limited. The contractor shall further provide such flagmen and watchmen as required by the Engineer or inspector for the protection of the public. The design, placement and maintenance of traffic control devices shall correlate with and so far, as possible conform to the system set forth in the most recent edition of the Manual on Uniform Traffic Control Devices for Streets and Highways. The roadway shall be properly maintained, and the contractor shall coordinate his operations with the Engineer in order that suitable arrangements may be made for detours, parking, access to private property, etc. Whenever a street is closed or partially closed, the City of Branson Police Department shall be notified of the closing, and when normal service is resumed. In the event it is determined that the contractor is not maintaining a safe roadway, the Engineer may improve the roadway conditions at the contractor's expense.

K. MOVING OF PUBLIC AND PRIVATE UTILITIES. In general, the moving of utilities within the limits of established right-of-way or public easements, which conflict with the improvement, will be done by the respective controlling utility at its own expense and at no cost to the Contractor. The Contractor shall notify the owners of each utility identified on the plans, prior to

the start of any construction. The work by these utilities may be completed before the Contractor progresses to the points affected. Under some circumstances, however, the work of the utilities may have to be performed during the Contractor's construction. It shall be the responsibility of the contractor to coordinate his work with that of the utility to cause the least possible delay in the work. No utility, public or private, shall be moved to accommodate the Contractor's equipment or his method of operation when such utility does not interfere with the improvement under construction, or to be constructed, unless all costs of such removal and replacement, when permitted, will be paid for by the Contractor.

L. PROTECTION OF PUBLIC AND PRIVATE UTILITIES. The Contractor shall be responsible for taking proper measures to support, sustain and protect existing pipes, conduits, poles, wires, and other apparatus under, over, along, across or otherwise affected by the work. If such pipes, conduits, poles, wires, or apparatus are damaged through carelessness or neglectful action of the Contractor, they will be repaired by the authorities having control of the same, but the cost of such repairs shall be paid by the Contractor.

The Contractor shall enlist the assistance of the affected agencies in the location of their utilities.

The Contractor shall be responsible to any agency for the cost of such assistance in the location of its utilities. If any underground facility not shown on the plans nor located by the utility agency is damaged by the Contractor, the Contractor shall be responsible for exercising good judgment and for taking such action as is reasonable and necessary to mitigate damages.

M. USE OF PRIVATE PROPERTY. The Contractor shall confine his work to the City's premises, including construction easements and construction permit lines. He shall not enter upon or place materials on any private premises except by written consent of the individual owners, and he shall save the City harmless from all suits and actions of every kind and description that might result from his use of private property.

N. DAMAGES. The Contractor hereby expressly binds himself or itself to indemnify and save harmless the City and its officers and employees against all suits or actions of every kind and nature brought or which may be brought, or sustained by any person, firm, or corporation, or persons, firms or corporations, in connection with or on account of the contractor's work or in consequence of any negligence in connection with same, or on account of any poor workmanship, or on account of any act of commission or omission of the contractor or his, its, or their agent or employees, or for any cause arising during the course of construction.

O. CLEANING UP. The Contractor shall frequently clean up all refuse, rubbish scrap materials, and debris because of his operations, so that at all times the site of the work shall present a neat, orderly, and workmanlike appearance. As may be ordered by the Engineer, and immediately after completion of the work, the Contractor shall at his own expense clean up and remove all refuse and unused materials of any kind resulting from the work. Upon failure to do so within 72 hours after such a request by the Engineer, the work may be done by the City and cost thereof charged to the Contractor and deducted from his final payment (if applicable). Upon completion of the work, the Contractor shall remove all his equipment and put the area of the work in a neat and

clean condition and do all other cleaning necessary to complete the work in a workmanlike manner satisfactory to the Engineer.

P. PROTESTS. If the Contractor considers any work demanded of him by the inspector to be outside the requirements of the specifications, he shall immediately ask for a written decision or instructions and shall proceed to perform the work to conform with the inspector's ruling. If the Contractor considers such instructions unsatisfactory, he shall, within twenty-four (24) hours after their receipt, file a written protest with the Engineer, stating his objections and the reasons therefore. Unless protests or objections are made in the manner specified and within the time limit stated herein, the contractor hereby waives all ground for protest.

Q. CONTRACTOR'S RESPONSIBILITY FOR WORK. Until work is accepted by the Engineer, it shall be in the custody and under the charge and care of the Contractor, who shall take every precaution against damage to the work, by action of the elements or any other cause. The Contractor shall rebuild, repair, restore and make good, at his own expense, all damages to any portion of the work before its completion and acceptance.

R. BLASTING. All blasting regulations shall comply with the Branson Municipal Code.

1. Notifications shall occur prior to beginning work. The contractor shall furnish the engineer’s letters of approval for the proposed operation from the appropriate regulating agencies. Whenever a new explosive materials storage location is established, including a temporary job site, the local law enforcement agency, fire department, and local emergency planning committee shall be notified 48 hours in advance, not including weekends and holidays, of the type, quantity and location of explosive materials at the site and shall provide proof of notice to the engineer. The contractor shall retain companies of all permits, blasting logs, and seismic monitoring data.
2. When blasting is to occur near existing in-ground structures, (manholes, lift stations, pipe, etc.), the contractor shall blast no closer than 50 feet from the structure unless special written permission is obtained from the director of public works/engineering prior to blasting, in which case, ground monitoring equipment shall be placed adjacent to the existing structure and no blasting may be conducted closer than 20 feet or the maximum particle velocity allowed on the existing structure shall be no greater than 2.0 inches per second whichever occurs first.

S. FINAL INSPECTION. As soon as practical after completion, the entire work will be examined thoroughly by the Engineer. The Contractor will be notified when the examination is to be made so that he, his representative, or both may be present. If the inspection reveals any defective or unsatisfactory work, it shall be replaced or repaired as the Engineer may order before final acceptance. The cost of all such repairs and replacements shall be borne by the Contractor.

T. ACCEPTANCE OF WORK.

1. Partial Acceptance. The City reserves the right to accept and make use of any completed section of the work without obligating the City to accept the remainder of the work or any

portion thereof; however, the warranty period shall start when the project is complete, and the City has issued the Project Completion Certificate.

2. Final Acceptance. When the final clean-up has been performed, the contractor shall notify the inspector in writing that all work has been completed. At the same time, the contractor shall notify the design engineer that the project has been completed and should forward to the design engineer all changes he has noted in his plans during the course of the work. Upon receiving such notification, the design engineer shall compute any changes in the original contract amount and send a letter to the City verifying the final contract amount. Within a reasonable time, the inspector shall perform all necessary inspection procedures on the completed work. The contractor shall receive written notification of any defects in the project. The Project Completion Certificate will be issued after all defects have been corrected. Issuance of the Project Completion Certificate by the City will constitute formal acceptance of the project and the commencement of the maintenance period specified in the maintenance bond form.

V. WARRANTY INSPECTION. A warranty inspection will be made forty-five to sixty days prior to the expiration date of the maintenance bond. The Contractor and surety will be notified when the examination is to be made so that they or their representative may be present.

Within the time period prescribed by the bond, the Contractor as ordered by the Engineer shall repair, replace, or rebuild such portions of the work which are found to be faulty because of materials or workmanship. The Contractor shall begin the remedial work not later than five (5) days after the order from the Engineer. In case the Contractor does not start the remedial work within the above time limit, or in case of an emergency condition caused by faulty work, the City may take remedial action and charge the cost thereof against the Contractor and his surety.

SECTION 1000 SITE PREPARATION

1001 SCOPE. This section governs the furnishing of all labor, equipment, tools and materials and the performance of all clearing, grubbing and demolition within the limits of work as defined in Section 1003(A) of this specification, in the Special Provisions or as shown on the plans.

1002 DEFINITIONS.

A. Clearing. Clearing shall consist of removing all vegetable matter such as trees, brush, down timber and other objectionable materials found on or above the surface of the site. It shall include removing buildings, fences, lumber, waste dumps and trash and the salvaging of such materials as may be specified and disposing of the debris. The Contractor shall scalp all excavation and embankment areas. Scalping shall include the removal of material such as sod, grass, residue or agricultural crops and decayed vegetable matter from the surface of the ground without removing more earth than is necessary.

B. Grubbing. Grubbing shall consist of removing and disposing of all vegetable matter such as stumps, roots, buried trees and brush encountered below the surface of the ground or sub-grade, whichever is lower, which have not been included in Section 1002(A) entitled "Clearing".

In all cases of grubbing, the vegetable matter shall be removed to a minimum depth of 12 inches below ground line or sub-grade, whichever is lower, except as provided in Section 1003(C).

When deleterious materials are encountered below ground line that may be detrimental to the proposed improvement, these shall be removed to a depth necessary to provide adequate support for the proposed improvement.

C. Demolition and Removal. This work shall consist of demolishing, removing and disposing of all structures and improvements within the construction limits unless included in other items of work as shown on the plans or Special Provisions. This work shall apply to all structures and improvements, whether on, above or below the surface of the ground or sub-grade.

Demolition and removal shall include but not be limited to items such as buildings, drainage structures, pipes, pavements, fences, retaining walls, guardrails and signs.

Items such as fences and guardrails shall be salvaged and relinquished to the appropriate owner or relocated, where indicated on the plans.

Relocation of signs, fences, guardrails, etc. shall be considered incidental to removal work except where such relocation is listed separately in the itemized Proposal.

All pipes that are to be abandoned shall be removed unless otherwise shown on the plans or approved by the Engineer.

In removing items such as Portland cement concrete pavement, base courses, curbs, curb and gutters, sidewalks, and similar objects where portions of said objects are to be left in place, these

items shall be removed to an existing joint or to a new joint sawed to a minimum depth of two inches (2") or 1/4 the slab thickness, whichever is greater, with a true line and vertical face. Sufficient portions of these objects shall be removed to provide for the proper grade and connection to the new work.

D. Trees. Vegetable growth 6 inches in diameter, measured three feet (3') above ground shall be classified as a tree.

E. Brush. Vegetable growth less than 6 inches in diameter, measured three feet (3') above ground shall be classified as brush.

1003 CONSTRUCTION DETAILS.

A. Limits of Work. The limits for clearing, grubbing and demolition shall extend to the construction limits unless otherwise shown on the plans. In the event construction limits have not been indicated on the plans, the limits for clearing, grubbing, and demolition shall not extend beyond the limits of the right-of-way, City property lines, or easements.

B. Protection of Greenery, Existing Structures and Private Facilities. The plans will designate trees, shrubs or other plants that are to be saved and the Contractor will take necessary steps to protect this greenery. Trees may be pruned, upon prior approval of the Engineer, but only in accordance with the best practices of arboriculture in respect to the individual species with due regard to their natural form and growth characteristics.

Existing structures within or adjacent to the construction limits that are not to be removed or demolished shall be protected by the Contractor during his construction. Any private facilities such as house sewer laterals which are disturbed or damaged by the Contractor's work, shall be repaired by the contractor prior to the close of the workday. This repair shall be made in a manner sufficient to restore utility service to that property.

C. Embankment Area. When undisturbed stumps and roots are encountered where the fill depth will exceed 3 feet the stumps and roots may be left in place provided, they do not extend more than 3 inches above the original ground line.

D. Borrow Areas. All stumps, roots and other objectionable matter shall be removed from the borrow material used for embankment or fill. The borrow area shall be left in a well-drained and smooth condition.

E. Backfilling the Site. All trenches, holes, pits and basement areas resulting from the operations of clearing, grubbing, demolition and removal on the site, shall be backfilled with suitable material placed and compacted in conformance with Section 1106 entitled "Embankment".

F. Disposal of Materials. All materials with the exception of those which are designated for salvage, or which are used in the embankment in conformance with this specification, shall become the Contractor's property and shall be disposed of by him, outside the project limits unless otherwise indicated on the plans.

1004 PROGRESS OF CONSTRUCTION.

A. Clearing. Clearing shall proceed well in advance of the construction operations so as not to delay the progress of the work. The refuse resulting from clearing may be hauled to a waste site secured by the Contractor or shall be burned or buried in such a manner as to meet all laws, regulations, and requirements of any governing authority regarding health, safety, and public welfare. When authorized by the Fire Department, the Contractor may dispose of such refuse by burning on the site of the project, provided all requirements as determined by the Fire Department are met. Under no circumstances will the authorization to burn on the site relieve the Contractor in any way from damages which may result from his operations. In no case should any materials be left on the project site, shoved into abutting properties, or buried in embankments or trenches on the site.

B. Grubbing. Grubbing shall parallel the clearing as nearly as the sequence of operations will permit.

Piling and butts of utility poles within the limits shall be removed to a minimum depth of two (2) feet below the subgrade or the original ground, whichever is lower.

All stumps, roots, and other objectionable matter found within borrow material to be used for embankment or fill material shall be removed.

C. Demolition. Demolition work shall occur well in advance of the construction operations. Masonry and concrete walls, miscellaneous foundations, or other objects extending below ground shall be removed to a depth of at least 12 inches below the original ground or subgrade, whichever is lower.

When explosives are used in demolition, the Contractor shall comply with the provisions of Specification Section entitled "Blasting".

1005 UTILITY COORDINATION.

The Contractor shall be responsible for protecting any improvement of any agency, public or private, in the vicinity of clearing, grubbing or demolition operations. When necessary, the Contractor shall enlist the assistance of the affected agencies in the location of their utilities. The Contractor will be responsible for the cost to any agency for assistance in utilities and for the cost of all damage to such facilities arising from his carelessness or negligence.

SECTION 1100 GRADING

1101 SCOPE. This section governs the performance of all work required to excavate, remove, dispose or compact all materials encountered within the limits of the project, at the locations shown on the contract documents.

1102 DEFINITIONS.

A. Grading. Grading as used herein shall mean the performance of all excavation, embankment, and backfill in connection with the construction of all improvements.

B. Excavation. Excavation is defined as the removal of materials from the construction area to the lines and grades shown on the plans.

1. Unclassified Excavation. Unclassified excavation is defined as the removal of all material encountered regardless of its nature. All material excavated will be considered as Unclassified Excavation unless the Special Provisions specify Classified Materials.

2. Rock Excavation. Rock excavation is defined as the removal of all rock ledges, occurring in its natural undisturbed, 6 inches or more in thickness, and detached rock or boulders having a volume of more than 1 1/2 cubic yards and shale occurring in its natural state, hard and non-weathered.

   A rock ledge is defined as a continuous body of rock which may include thin interbedded seams of shale or other soft materials less than 12 inches thick. The vertical limit of each ledge shall be defined by interbedded seams of soft materials 12 inches in thickness. The beds of soft interbedded material 12 inches in thickness shall not be included in the measurement of "Rock Excavation" but shall be included in the measurement for "Earth Excavation".

3. Earth Excavation. Earth excavation is defined as the removal of all material not defined as rock.

C. Embankment or Backfill. Embankment or backfill is defined as the placing and compacting of material in the construction area to the lines and grades shown on the plans.

1. Unsuitable Material. Unsuitable material is defined as muck, frozen material, organic material, topsoil, rubbish, and rock with a maximum dimension greater than 12 inches.

2. Suitable Material. Suitable material is defined as entirely imperishable with that portion passing the No. 40 Sieve having liquid limit not exceeding 40 and a plastic index not exceeding 25, when tested in accordance with ASTM D-4318-00.

a. Rock Embankment. Material for rock embankment shall be free of unsuitable material and shall contain, by volume, greater than 60 percent rock or gravel having a maximum dimension greater than 3 inches but not greater than 12 inches.

b. Earth Embankment. Material for earth embankment shall be free of unsuitable material and shall, contain by volume, less than 40 percent rock or gravel having a maximum dimension greater than 3 inches.

D. Borrow. Borrow is defined as approved material excavated from an area outside the project limits and required for the construction of the embankment.

E. Waste. Waste is defined as excavation material not used in the embankment and disposed of outside the embankment areas or removed from site as dictated by engineer.

F. Structures. Structures as used herein refers to bridges, culverts, storm sewer and/or sanitary appurtenances, retaining walls and similar construction.

1103 CONSTRUCTION DETAILS - GENERAL. The contractor shall adhere to all statutes regarding the notification of utilities prior to beginning any work within public right-of-way. Relocation or protection of any existing utilities located in street right-of-way shall be governed by the applicable section of these Specifications. The relocation and/or protection of any utility that is shown on the plans, that lies within a utility easement and is endangered by this construction shall be the responsibility of the contractor.

The contractor shall make every reasonable effort to protect private facilities. These facilities may not be shown on the plans. When these facilities are disturbed or damaged by work, the contractor shall make necessary arrangements for repairs to the facilities for continuous service prior to the close of that workday.

It shall be the responsibility of the contractor to protect all property lot corners and control monumentation. Should it be necessary to disturb such monument, whether stake, pin, bar, disk, box, or other, it remains the responsibility of the contractor to reference such markers prior to removal, reset them, and file such relocations or monumentation documents as the law may require. Any such references, removal, replacement, and certification of monuments shall be performed by a surveyor registered and licensed in the State of Missouri. A copy of all such certification documents shall be provided to the Engineer prior to completion of the project. Any monument destroyed or improperly reset by the contractor may be replaced by the Engineer to the standards required by law at the expense of the contractor.

Grading, excavation, and backfilling for all improvements shall be made to the lines, grades, and cross section indicated by the plans. In addition, to any erosion control measures shown on the plans, the contractor shall schedule and conduct his operation in such a manner and shall provide any necessary control facilities to protect downstream and adjacent properties from pollution, sedimentation or erosion caused by the grading operations. Any pollution or damage occurring because of the work shall be the responsibility of the contractor.

During construction the graded area shall be maintained by the contractor in such a condition that it will be well drained at all times. Roadway ditches, channel changes, inlet and outlet ditches and other ditches in connection with the roadway shall be cut and maintained to the required cross section. All drainage work shall be performed in proper sequence with other operations. All ditches and channels shall be kept free of debris or obstructions.

1104 EXCAVATION. This section governs the excavation for all improvements. All suitable material removed by excavation shall be used as far as practicable in the formation of embankment as required to complete the work. The contractor shall sort all excavating material and stockpile when necessary, so as to provide suitable materials for embankments.

After removal of the roadway excavation material to the required section, all material between lines 1 foot outside the curbs and within the top 6 inches of the subgrade shall be compacted to 95 percent of maximum density for the material as defined in Section 1106(E).

Rock encountered within the full width of the roadway, toe of slope to toe of slope, shall be under graded to an elevation of 6 inches below the finished subgrade elevation. Care shall be taken to avoid overshooting when blasting. Rock shall be removed in such a manner as to leave no excessive water pockets on the surface.

Areas of under grading or overbreak in rock between lines 1 foot outside of the curbs shall be backfilled with spalls, rock fragments or granular type material. Backfill materials shall have a plasticity index not to exceed 10 and a gradation such that at least 50 percent of the material will be retained on the No. 4 Sieve.

1105 UNDERGRADING. Where materials are encountered which are deemed as unsuitable by the Engineer for use in the work, they shall be removed to the depth and limits as ordered by the Engineer. Areas under graded shall be backfilled in 6” lifts with one of the following materials:

A. Rock fragments or spalls.

B. A granular type of material having a plasticity index not to exceed 10 and a gradation such that at least 50 percent of the material will be retained on the No. 4 Sieve and no more than 40 percent will pass the No. 10 Sieve.

C. A material meeting the requirements of Section 1102(C,2).

1106 EMBANKMENT. This section governs embankments for all improvements. The embankments shall be constructed using suitable materials, as herein defined, procured from excavations made on the project site or from borrow areas as required to complete the grading work.

A. Starting the Embankment. Where embankments, regardless of height, are placed against hillsides or existing embankments, either of which have a slope steeper than 1 vertical to 4 horizontal, the existing slope shall be benched or stepped in approximately 24 inches rises as the new fill is brought up in 9 inch maximum layers or lifts. The material bladed out, the bottom of the area cut into, and the embankment material being placed, shall be compacted to the required density.

Material cut out, bladed into place, and compacted shall not be measured and paid for directly but will be considered as incidental work. The existing surface upon which embankment material is to be placed shall have all unstable and unsuitable material removed before starting the embankment work.

Where embankments two feet (2') or less in depth are to be placed on areas covered by existing pavement, the existing pavement shall be removed, and the cleared ground surface shall be compacted to the specified density. Where embankments greater than two feet (2') in depth are to be placed on areas covered by existing pavement, the existing pavement shall be broken into pieces not larger than 24-inches maximum dimension, left in place and the embankment started thereon.

B. Placing Earth Embankment. Earth shall be placed in successive horizontal layers distributed uniformly over the full width of the embankment area. Each layer of materials shall not exceed 12 inches maximum in thickness (loose state) and shall be compacted to not less than the required density before the next layer is placed thereon. As the compaction of each layer progresses, continuous blading, or dozing will be required to level the surface and to insure uniform compaction. Embankment construction shall not be performed when material contains frost, is frozen or is snow covered.

C. Placing Earth and Rock Embankment. When earth and stone or rock fragments are mixed in the embankment, all stones or rock fragments exceeding the thickness of the compacted lift shall be disposed of by being incorporated into the embankment outside the limits of the proposed surfaced areas. The thickness of the layer in these areas may be increased if necessary to accommodate the rocks but shall not exceed 15 inches in thickness (loose state). The stones or rock fragments are to be placed so there will be no nesting.

D. Consolidated Rock Embankment. When the excavated material consists predominantly of stone or rock fragments of such size that the material cannot be placed in layers of the thickness prescribed, such material shall be placed in the embankment in layers having a thickness of approximate average size of the larger rocks but not to exceed 24 inches. Rock or boulders too large to permit placing in a 24-inch layer shall be reduced in size as necessary to permit placement. Rock shall not be dumped in place but shall be distributed by blading or dozing in a manner to insure proper placement in final position in the embankment. The spalls and smaller stone fragments shall be left on the surface of each layer as formed. Each layer shall be thoroughly consolidated before the next layer is placed.

E. Compacting the Embankment. Before placing any embankment, the surface of the existing ground shall be prepared as heretofore specified, moistened as required, and the top six inches (6") compacted to a density of 90 percent as prescribed by the following paragraph.

All embankments shall be compacted to a density of at least 90 percent of the maximum density for the material used as determined by ASTM D-698 and within a tolerance of plus or minus three percent (3%) and plus two percent (2%) of the optimum moisture as maximum density as determined by the Moisture Density Curve obtained. In addition to the above required compaction, the subgrade between lines 1 foot outside of the curbs and within the top 6 inches of

the subgrade shall be compacted to a density of at least 95 percent of the maximum density for material used as determined by ASTM D-698 and with a tolerance of plus or minus three percent (3%) of the optimum moisture as maximum density as determined by the Moisture Density Curve obtained.

All work involved in either adding moisture to or removing moisture from embankment materials to within these moisture limits shall be considered incidental to the completion of the grading operation.

F. Consolidated/Compacted. Consolidation and compaction will be placed not to exceed 9 inch layer and spread with equipment weighing a minimum of 15,000 pounds and delivering a dynamitic of 30,000 pounds during the vibratory operation as determined by Missouri Standard Specifications for Highway Construction Section 203.

G. Moisture - Density Determination. In-place density and moisture content of the embankment will be determined by ASTM D-1556-00; or ASTM D-2167-94; or by Nuclear Methods, ASTM D-2922-01.

H. Backfilling Curb and Gutter. Backfilling behind curb or curb and gutter shall be done within seven (7) days after being laid unless otherwise approved by the Engineer. Unless otherwise shown on the contract drawings, the finish grading from the back of the curb to the right-of-way line and/or utility easement line or construction easement line shall be performed to provide a smooth transition between existing yard grades at the right-of-way line and/or easement line to the curb so that positive drainage will exist.

The top portion of the backfill within right-of-way areas shall be finished with topsoil corresponding to, or better than, underlying adjoining sodded areas. Topsoil shall be approved by the Engineer prior to placement, and unless otherwise directed, shall be material previously excavated and stockpiled for the purpose during excavating and grading operations. Immediately prior to dumping and spreading topsoil, the surface shall be loosened by discing or scarifying to a depth of two inches (2") to permit bonding of the topsoil to the underlying surface.

# SECTION 1200 SUBGRADE PREPARATION

1201 SCOPE. This section governs the furnishing of all labor, equipment, tools, and materials, and performance of all work connected with subgrade preparation, prior to constructing pavements for streets, alleys, parking areas, sidewalks, drive approaches and the construction of concrete curb and curb and gutters. This section does not include the construction of any base courses.

## 1202 DEFINITIONS.

A. Subgrade. Subgrade is defined as a well-graded and compacted surface, constructed as specified herein to the grades, lines and cross-section shown, bladed, and compacted to the specified density, preparatory to constructing pavements, or other improvements thereon.

B. Subgrade Preparation. Subgrade preparation is the repeated operation of fine grading and compacting the subgrade until the specified lines, grades, and cross-sections have been obtained and the materials are compacted to the specified depth and density.

## 1203 CONSTRUCTION REQUIREMENTS.

A. General. All underground work contemplated, including clearing, grubbing, and demolition, shall be completed in accordance with the requirements of Section 1100 "Grading" prior to commencement of any subgrade preparation.

The subgrade surface shall be brought to the specified lines, grades, and cross-sections by repeatedly adding or removing material and compacting to the specified density with suitable equipment to perform these operations. Tolerance allowed on all lines, grades and cross-sections shall be a compensating maximum deviation of 1/4 inch.

B. Foundation Treatment. Unless otherwise specified or shown on the contract drawings, the soil below grade line in cut sections shall be scarified, broken up, adjusted to a moisture content within the designated moisture range and compacted to the designated type of compaction.

The top six inches (6”) of subgrade for pavements shall be compacted to 95 percent of the maximum density for the material used as determined by ASTM D-698 and within a tolerance of plus +/-(3%) of the optimum moisture at maximum density as determined by the moisture density curve obtained.

C. Moisture Control Requirements. The moisture content of the soil at the time of compaction shall be as necessary to obtain the density as designated on the contract drawings unless it is determined by the Engineer that the soil is unstable with that moisture content.

When the moisture content of the soil is not satisfactory to the Engineer, water shall be added or the material aerated, whichever is needed to adjust the soil to the proper moisture content. In no case shall water be added without the consent of the Engineer.

D. Compaction Control Requirements. Roadway embankment earth (fill) materials shall be placed in horizontal layers not exceeding 9 inches unless otherwise approved by the Engineer and shall be compacted as specified in Section 1205 "Compaction Requirements" before the next layer is placed. Effective spreading equipment shall be used on each lift to obtain uniform thickness prior to compaction. Water shall be added or removed on the approval of the Engineer, to obtain the required density.

1204. MOISTURE CONTENT REQUIREMENTS. The moisture content of the soil at the time of compaction shall be uniform and shall be such that the soil can be compacted to the requirements of the type of compaction as designated on the contract drawings or as directed by the Engineer.

1205 COMPACTION REQUIREMENTS.

A. Pavements. The subgrade for pavements shall be compacted to a density of at least 95 percent of the maximum density for the material used for a depth of at least six inches (6") below the finished subgrade elevation and within the tolerance of the moisture for the type of material at 95 percent of maximum density, as determined by the standard proctor test (ASTM D698) for cohesive soils. Any further compacted layers shall be accomplished in the same manner as specified.

Compaction of low plasticity or non-plastic, fine-grained material shall be considered adequate when additional passes of the roller do not bring the tamping feet closer to the surface of the lift, provided the entire weight of the roller is supported on the tamping feet and none by material directly in contact with the drum.

Sand and gravel which cannot be compacted satisfactorily with a sheepsfoot roller shall be rolled with a pneumatic-tired roller.

Each lift shall be rolled until no further consolidation is evident.

B. Sidewalks. The subgrade for sidewalk pavements shall be compacted to a density equivalent to the density of the immediately surrounding soil in areas not requiring fill. In areas where fill is required, the subgrade shall be compacted to 95 percent of the maximum dry density as determined by ASTM D698 for cohesive soils or (70) percent relative density as determined by ASTM D2049 for non-cohesive soils.

C. Drive Approaches and Concrete Curb & Gutter. The subgrade for drive approaches and concrete curb and gutter shall be compacted to the same requirements as stated above in part A Pavements.

1206 PROTECTION AND MAINTENANCE OF SUBGRADE. The newly finished subgrade shall be repaired from action of the elements or others. Any settlement or erosion that occurs prior to placing the pavement thereon the acceptance of the work, shall be repaired and the specific lines, grades and cross-section reestablished.

Any subgrade that has become unacceptable shall be reworked as necessary to restore the subgrade to shape, tolerance, density, and moisture content range for such density, immediately prior to the placing of the pavement.

The Contractor shall protect all existing improvements from damage resulting from his subgrade operation. Any improvement damaged shall be repaired or replaced by the Contractor at his own expense.

1207 CLEAN-UP. Subgrade clean-up shall follow the work progressively. The Contractor shall remove from the project site all rubbish, equipment, tools, surplus or discarded material and temporary construction items.

1208 COMPACTION TESTING. At the option of the Engineer, compaction testing may be performed in the field using a nuclear density-moisture measuring devise to determine the density of the subgrade. If as a result of this field testing the Engineer determines that further compaction is required, the Contractor shall revise his methods or procedures to obtain the specified density. A copy of all test results shall be provided to the Engineer or his designated representative.

1209 PROOF ROLLING. Proof rolling with a heavy rubber-tired roller will be required when ordered by the Engineer or his designated representative. Proof rolling shall be done after specified compaction has been obtained. Areas found to be weak (exhibit excessive pumping) and those areas which fail shall be ripped, scarified, wetted, or dried if necessary and re-compacted to the requirements for density and moisture at the contractor's expense. The operating weight of the roller shall be not less than 12-1/2 tons per wheel. Tires shall be inflated to a minimum pressure of 70 pounds per square inch and a maximum pressure of 90 pounds per square inch.

SECTION 1250 AGGREGATE BASE COURSE

1251 SCOPE. This section governs the furnishing of all labor, materials, and equipment for the placement of aggregate base course material as shown on the Plans and in accordance with the Standard Drawings, the specifications and the Special Provisions.

1252 MATERIALS.

A. Untreated Compacted Aggregate: This base course material shall consist of crushed stone aggregate with not more than 1.0% clay lumps and friable particles in accordance with ASTM C 142, and free from vegetable or other deleterious substances. The abrasion loss shall be no more than 35% when tested in accordance with ASTM C 131. That fraction passing the 1-inch sieve and retained on the No. 4 sieve shall have a loss not greater than 18% by weighted average for magnesium sulfate method (12% maximum loss if tested using sodium sulfate method) of ASTM C 88 Soundness Test at 5 cycles. That fraction of the material passing the 1-inch sieve and retained on the No. 4 sieve shall contain less than 20% by weight of flat and elongated particles when tested in accordance with ASTM D 4791 (flat being a ratio of 1 to 3 between thickness and least width and a ratio of 1 to 3 between the least width and length). The material shall consist of angular particles with no less than 90% of particle count having two or more fractured surfaces. The gradation in percentages by weight passing square mesh sieves shall be in accordance with ASTM C 136 and as follows:

| Sieve Designation (Square Opening) | Percentage by Weight Passing Sieve |
|---|---|
| 1-1/4 in (31.5 mm) | 100 |
| 1 in (25.0 mm) | 72-100 |
| 3/4 in (19.0 mm) | 60-90 |
| 3/8 in (9.5 mm) | 43-74 |
| No. 4 (4.75 mm) | 28-60 |
| No. 10 (2.00 mm) | 16-40 |
| No. 40 (425 um) | 3-22 |
| No. 200 (75 um) | 0-15 |

In addition to the above limits, the difference between the "Percent Passing Square Mesh Sieve" of successive sieve sizes shall not exceed 25 percent.

That fraction of the material passing the No. 40 sieve shall have a plasticity index not to exceed 8 when tested in accordance with ASTM D 4318.

B. Drainable Base: All drainable base materials shall have a minimum coefficient of permeability of 1000 ft./day as determined by the APWA Permeability Test Procedure.

1. Portland Cement Concrete Drainable Base: This item shall consist of an open-graded drainable base composed of mineral aggregate, Portland cement and water mixed in a central mixing plant and placed on a prepared course in accordance with these

specifications and shall conform to the lines, grades, thicknesses and typical cross sections shown on the Plans.

a. Coarse Aggregate

i. General: Coarse aggregate shall be 3/4-inch maximum size consisting of crushed gravel or crushed stone and shall meet the requirements of ASTM C 33 and quality requirements of 2203.3.A.

ii. Gradation shall be ASTM C 33, Size 67.

b. Fine Aggregate: Fine aggregate shall consist of natural sand or manufactured sand meeting the requirements of ASTM C 33.

c. Cement: Portland cement shall conform to the requirements of ASTM C 150, Type I or Type II. Substitution of fly ash or other pozzolan for Portland cement shall be in conformance with Section 2003.

d. Water: Water used in mixing or curing shall be clean and free of oil, salt, acid, alkali, sugar, vegetable, or other substances injurious to the finished product as possible. Water known to be of potable quality may be used without testing.

e. Admixtures: The use of any material to be added to the mixture shall be approved by the Engineer. The Contractor shall furnish vendor's certified test reports for the materials used in the project. The report shall be delivered to the Engineer as part of the mix design before permission to use the materials is granted.

f. Proportions: The Contractor shall submit a mix design containing the quantity of each material to the Engineer including certifications of materials used. The Contractor will be responsible for preparing the drainable base mix design at no cost to the Owner. The testing laboratory preparing the mix design shall comply with Section 2000. The mix design shall include the following:

Cement Content
Water-Cement Ratio - Approximately 0.36
Coarse Aggregate
Fine Aggregate.
All Admixtures
Coefficient of Permeability - Tested per Section 1250.D.3

g. Compressive Strength: Proportions will be such to produce a compressive strength of 800 psi in 28 days as determined by test cylinders made in accordance with ASTM C 31 and tested in accordance with ASTM C 39. A strength of 500 psi will be required prior to any traffic being allowed on the surface.

2. Plant Mix Bituminous Drainable Base: This item shall consist of an asphalt stabilized drainable base course composed of mineral aggregate and bituminous material mixed in

a central mixing plant and placed on a prepared course in accordance with the specifications and shall conform to the lines, grades, thicknesses, and typical cross sections shown on the Plans. Each course shall be constructed to the depth, typical section, or elevation required by the Plans and shall be rolled, finished, and approved before the placement of the next course. A prime coat will be used on the subbase prior to placement of the first course, and no tack coat will be used between courses.

a. Aggregate: Aggregate shall consist of crushed stone or crushed gravel and be free of organic materials.

   i. Coarse Aggregate: Coarse aggregate shall comply with Section 2000 except wear may not exceed 50% in accordance with ASTM C 131.
   ii. Aggregate shall contain at least 70% by weight of individual pieces having two fractured faces and 85% by weight having at least one fractured face as determined by ASTM D 5821. The aggregate shall not contain more than 8%, by weight, of flat and elongated pieces, when tested in accordance with ASTM D 4791 (ratio = 5:1).
   iii. Sampling: ASTM D 75 shall be used in sampling the coarse aggregate.

b. Bituminous Material: The asphalt cement shall be in conformance with Section 1403.A. The type and grade of asphalt used shall be specified in the mix design but shall not be lower than a PG 64-22.

c. Preliminary Material Acceptance: Prior to delivery of materials to the job site, the Contractor shall submit certified test reports to the Engineer for the following materials:

d. Coarse Aggregate - Percent of wear, soundness.

e. Bituminous Material - The certification(s) shall show the appropriate ASTM test(s) for each material, the test results, and a statement that the material meets the specification requirements.

f. Job Mix Formula. (JMF): No bituminous mixture for payment shall be produced until the Engineer has approved a JMF in writing. The method of determining the proper asphalt content is to store the mix trial batches in the laboratory overnight (15-18 hrs.) at 140°F. The proper asphalt content will then be selected visually. The asphalt content mix is selected from the batch from which a small amount of asphalt drains to the bottom of the pan and the mix still appears glossy. A heat resistant, clear glass dish may be used for better visibility of the drained asphalt. The asphalt content may be varied as necessary during construction to meet this requirement. The aggregate shall be of such size that the percentage composition by weight will conform to the gradation of gradations specified in Table 2, when tested in accordance with ASTM C 117 and C 136. The gradation shall be on the coarse side of the Master Band.

| TABLE 2. PLANT MIX BITUMINOUS DRAINABLE BASE MASTER GRADATION | |
|---|---|
| Sieve Designation (Square Opening) | Percent by Weight Passing Sieve |
| 1-1/2 in (37.5 mm) | 100 |
| 1 in (25.4 mm) | 90 – 100 |
| 3/4 in (19.0 mm) | 75 – 100 |
| 1/2 in (12.5 mm) | 70 – 90 |
| 3/8 in (9.5 mm) | 50 – 70 |
| No. 4 (4.75 mm) | 20 – 40 |
| No. 8 (2.36 mm) | 15 – 25 |
| No. 30 (637 um) | 5 – 15 |
| No. 200 (75 um) | 0 – 3 |

Recommended Asphalt Cement Content 2.0% – 3.5%

The gradations in Table 2 represent the limits that shall determine the suitability of aggregate for use from the supply source.

The job mix tolerance shown in Table 3 shall be applied to the JMF to establish a job control grading band. The resulting job control grading band must comply with the Master Gradation criteria.

| TABLE 3. JOB MIX FORMULA TOLERANCES (Based on Single Test) | |
|---|---|
| **Material** | **Tolerance Plus or Minus** |
| Aggregate passing No. 4 (4.75 mm) sieve or larger | 5.00% |
| Bitumen* | 0.40% |
| Temperature* | 20 degrees F |

*Unless otherwise approved by the Engineer

The aggregate gradation may be adjusted within the limits of Table 2 as directed, without adjustments in the Contract unit prices.

Should a change in sources of materials be made, a new JMF shall be established before the new material is used.

Dry aggregate gradations will be made at least twice daily. The aggregate gradation shall be tested by the Contractor in accordance with ASTM C 117 and C 136 and the results submitted to the Engineer within 24 hours.

The JMF shall be submitted in writing by the Contractor and approved by the Engineer prior to the start of paving operations. The job mix shall have been prepared no more than 12 months prior to submittal and shall include as a minimum:

Percent passing each sieve

Percent of asphalt cement
Asphalt designation and certifications
Mixing temperature
Compaction temperature
Temperature of mix when discharged from the mixer
Percent fractured faces
Percent elongated particles

The Contractor shall submit samples to the Engineer, upon request, for job mix formula verification testing.

g. Testing Laboratory: The laboratory used to develop the JMF formula shall meet the requirements of ASTM D 3666.

## 1253 CONSTRUCTION REQUIREMENTS.

### A. Untreated Compacted Aggregate

1. Subgrade: Prior to placement of base course material, the previously prepared subgrade surface shall be cleared of all foreign substances and restored in shape, tolerance and density as specified in Section 1200 entitled "Subgrade Preparation".

2. Material Placement: The material shall be uniformly spread in successive layers to such depth that when compacted, the base will meet the minimum thickness specified. The Contractor may construct the base in any number of layers that he chooses except that in no case shall any individual layer have a compacted thickness of more than 6 inches. Each layer shall be compacted as hereinafter specified before any succeeding layer is placed.

3. After spreading a layer of material, water in an amount sufficient to ensure the desired compaction shall be added and uniformly mixed with the aggregate in a manner to prevent segregation. Excess moisture resulting in runoff shall be avoided. If for any reason, the material and subgrade become too wet to permit satisfactory work, they shall be allowed to dry to a moisture content that will permit satisfactory work.

4. The material shall meet the required specifications immediately before compaction operations are commenced. If, for any reason, segregation occurs in excess of 10% variation from the gradation required by this specification or the materials become contaminated, such segregated or contaminated materials shall be removed and replaced with suitable materials at the expense of the Contractor. The limited segregation of 10% variation will be ascertained by a sieve analysis of a minimum 100-pound sample taken from the in-place base course.

5. However, for untreated compacted aggregate base, segregated surface areas may be corrected by adding limestone screenings of such gradation and quantity as required to fill the surface voids and firmly bind the loose material in place. Screenings so used in correcting segregated surface areas will be subsidiary.

6. Shaping and compacting shall be carried on continuously until a true, even and uniform surface of proper grade and cross-section is obtained, and until the density of the complete base is at least 95% of maximum density as determined by AASHTO T 99. The proper moisture content shall be maintained by wetting the surface as required during shaping and compacting operations. Final rolling shall be accomplished by use of a self-propelled smooth-wheeled roller.

B. Portland Cement Concrete Drainable Base.

1. Spreading: The base material shall be spread to the lines and grades shown on the Plans. Any material which becomes mixed with soil or other contaminants shall be removed and replaced with fresh mixture.

2. Compaction: After spreading and/or trimming, the base material shall be uniformly compacted by making a minimum of 2 coverages with a steel wheeled roller meeting the requirements of 2023 MoDOT Standard Specifications for Highway Construction. The compaction process may be adjusted on the project by the Contractor with approval of the Engineer to assure uniform compaction of the drainable base material. In areas not accessible by the roller, the base material shall be compacted by mechanical hand methods. Compaction must be completed within 2 hours of the time water is introduced to the mixture.

3. If after spreading and compacting the base is not to the required lines and grade, the Contractor shall trim the base by means of an electronically controlled machine utilizing string line controls for grade. The Engineer reserves the right to direct the Contractor to suspend all operations if the Contractor produces excessive fines in the trimming process which are viewed by the Engineer to be detrimental to the permeability of the base. Appropriate corrections to the trimming process shall be made by the Contractor prior to beginning again.

4. After compaction of the drainable base, the Contractor shall protect the surface from damage and/or contamination. If the integrity of the drainable base is disturbed at any time prior to placement of the succeeding pavement course the area shall be removed and replaced with new material and compacted to conform to the original lines and grades at the Contractor's expense. Any removed material shall not be reincorporated into the drainable base or other drainage features.

5. Curing of The Drainable Base Material: The Contractor will be required to provide a curing plan to the Engineer.

6. Temperature Limitations: The air temperature must be between 50°F and 90°F for drainable base construction. The Engineer may order operations to cease in hot windy conditions if it appears the mixture is drying out prior to achieving initial set.

7. Construction Joints: The formation of all joints shall be made in such a manner as to ensure a continuous bond between old and new sections of the course. All joints shall present the same texture and smoothness as other sections of the course.

8. All contact surfaces of previously constructed courses shall be cleaned of all dirt or other objectionable materials, and thoroughly moistened with water prior to placing the new material.

9. Thickness: The thickness of the base course may be measured by cores taken at intervals determined by the Engineer.

C. Plant Mix Bituminous Drainable Base.

1. Test Section: Prior to full production, the Contractor shall prepare and place a section of drainable base according to the JMF. The amount of mixture should be 80 tons and may be placed as part of the project. The underlying grade or pavement structure upon which the test section is to be constructed shall be the same as the remainder of the course represented by the test section. The equipment used in construction of the test section shall be the same type and weight to be used on the remainder of the course represented by the test section.

2. Two random samples of mixture may be taken at the plant and tested for aggregate gradation and asphalt content. The test section shall be considered acceptable if the gradation and asphalt content are within the limits specified in Tables 2 and 3.

3. If the initial test section should prove to be unsatisfactory to the Engineer, the necessary adjustments to the JMF, plant operation, placing procedures, and/or rolling procedures shall be made. A second test section shall then be placed. If the second test section also does not meet specification requirements, both sections shall be removed at the Contractor's expense. Additional test sections, as required, shall be constructed and evaluated for conformance to the specifications. Any additional sections that do not conform to specification requirements shall be removed at the Contractor's expense. Full production shall not begin until a satisfactory section has been constructed and accepted by the Engineer. The test sections that meet the specification requirements shall be paid for in accordance with project quantities.

4. The Contractor shall perform job mix control testing at the start of plant production and in conjunction with the calibration of the plant for the JMF. It should be recognized that the aggregates produced by the plant may not satisfy the gradation requirements or produce a mix that exactly meets the JMF. In those instances, it will be necessary to reevaluate and redesign the mix using plant-produced aggregates. Specimens should be prepared, and the optimum bitumen content determined in the same manner as for the original design tests.

5. Weather Limitations: The bituminous mixture shall not be placed upon a wet surface or when the surface temperature of the underlying course is less than 40 degrees F or the

wind chill factor is less than 35 degrees F. The temperature requirements may be waived by the Engineer; however, all other requirements including compaction shall be met.

6. These materials will be placed, handled, hauled, and accepted based on requirements of Section 1400.

D. Permeability Test Procedure for Drainable Base.

This test method is used to determine the permeability of unbound and bound aggregate base material. Use Portland cement or asphaltic cement as a cementing agent for bound base material.

1. Unbound Base and Base Bound with Portland Cement

a. Apparatus

i. Mold: A cylindrical metal mold with an approximate inside diameter of 6" and a minimum height of 6". The mold shall be equipped with a removable collar at least 2" in height and a removable base plate. The base plate may be used as part of the permeability test equipment. If so, the base plate must exceed the permeability of the material being tested. A #40 screen shall be placed on top of the base plate to prevent test material from being lost through the base plate during compaction and permeability testing.

ii. Standpipe: A standpipe with the same diameter as the removable collar for the mold with a minimum height of 8.5". The standpipe shall be equipped with an overflow outlet.

iii. Rammer: A mechanically operated metal rammer equipped to control the height of drop to 12" plus or minus 1/16" above the elevation of the sample. The rammer shall be equipped to distribute the blow uniformly over the sample surface. The rammer shall have a rigid flat faced "pie shaped" foot and a nominal weight of 5.50 lbs. The "pie shaped" foot shall be a sector of 6" diameter circle and shall have an area equal to that of a 2" circular foot.

iv. Straight edge: A rigid steel straight edge with one edge beveled, at least 8" in length.

b. Sample preparation

i. Obtain a 50 lb. to 60 lb. sample, dry if necessary.

ii. Mix a sufficient amount of aggregate and cementing agent, if required, to fill the mold 1 and 1/2 times.

iii. Add the appropriate amount of water and thoroughly mix.

iv. Place the assembled mold on the rigid base and fill approximately 1/2 full of the loose moist material. Compact the layer with 25 blows of the rammer with the blows being distributed uniformly over the surface of the layer.

v. Place three additional approximately equal layers of material in the mold and compact each layer in a similar manner (four layers total).

vi. After the fourth layer has been compacted, remove the collar and trim excess material level with top of the mold.

vii. Cure Portland cement treated specimens by covering them with plastic, to prevent drying for 3 days at room temperature.

viii. Unbound specimens do not need to be cured before testing.

2. Asphalt Bound Aggregates

a. Apparatus

i. Mold: A cylindrical mold with an inside diameter of approximately 6" and a minimum length of 4.5". The mold is open at each end and is equipped with a removable collar and a base plate about 0.5" thick.

ii. Specimen Mold Holder: The specimen mold holder has a semi-circular base and a flanged top to hold the specimen mold in place during the compaction process. Any equivalent hold down device that performs the same function is satisfactory.

iii. Compaction Hammer: The compaction hammer consists of a hammer having a flat circular tamping face 5.88" in diameter and appropriate extension rod with handle which acts as guide for a free-falling weight. The weight shall weigh 22.5 lbs. and have a free fall of 18" plus or minus 0.1". The hammer may be operated manually or be driven with a motor.

iv. Compaction Pedestal: The compaction pedestal is a wood block approximately 12" x 12" x 18". A 12" x 12" x 1" steel plate is securely fastened to the top of the block. The pedestal is set on and securely fastened to a solid concrete slab with the vertical axis plumb and the top level.

v. Heating Equipment: Ovens or hot plates for heating aggregates, bituminous material, specimen molds, compaction hammers and other associated items required for mixing and molding. It is recommended that, when possible, all heating units be thermostatically controlled to maintain the required temperature within ±5°F. Suitable shields, thick steel plates or pans of sand shall be used on the surfaces of hot plates to minimize locally overheating.

vi. Mixing Apparatus: Mechanical mixing is recommended. Any type of mechanical mixer may be used provided it will produce a well coated, homogeneous mixture of the required amount in the allowable time and further that the mixing paddle or whip does not fracture or pulverize aggregate fractions during the mixing process. The bowl employed with the mixer shall be of such a nature that essentially all of the batch can be removed. More than one mixing bowl is recommended unless the mixer is equipped with a heating jacket to keep the bowl heated during the mixing process.

b. Determination of Mixing and Compacting Temperature

i. The temperature to which the asphalt cement must be heated to produce a viscosity of 85 ± 10 SFS shall be the mixing temperature.

ii. The temperature to which the asphalt cement must be heated to produce a viscosity of 130 ± 15 SFS shall be the compacting temperature.

c. Sample Preparation for Laboratory Prepared Mix

i. Combine the dry individual aggregates to produce desired combined aggregate with a batch weight of approximately 8.9 lbs. This should be sufficient to produce a compacted specimen 3.75 ± 0.125 inches thick. Adjust the weight of the batch as needed to produce a compacted specimen of 3.75 ± 0.125 inches thick.

ii. Prepare a minimum of two aggregate and asphalt specimens. The first specimen shall be mixed and thrown away. This sample is to "butter" the mixing bowl and paddle and thus reduce material loss when mixing the test specimen.

iii. Heat the aggregate and asphalt within the limits of mixing temperature determined in Section 1253.D.2.b. Charge the mixing bowl with the heated aggregate and form a crater in the top. Add the required amount asphalt and mix the aggregate and asphalt until coated at least 2 minutes. Care should be taken to keep all of the sample in the mixing bowl during this process.

d. Compaction of Specimen

i. Prior to the addition of the asphalt to the batches, thoroughly clean the specimen mold assembly and the face of the compaction hammer and heat the mold assembly and hammer to a temperature between 200°F and 350°F. Assemble the mold, base plate and collar and place a paper disc cut to size in the bottom of the mold.

ii. Place the hot batch of aggregate-asphalt mixture in the mold, spade vigorously with a heated spatula or trowel 15 times around the perimeter and 10 times over the interior of the mold. Smooth the surface of the mix to a slightly rounded shape. The temperature of the mix prior to compaction shall be within the limits in Section 1253.D.2.b. Place a paper disc on top of the mix.

iii. Place the mold assembly, including the collar, on the pedestal, fasten securely with the mold holder and apply 20 blows with the compaction hammer. Each blow must have the prescribed free fall of 18" with the axis of the compaction hammer held perpendicular to the base of the mold assembly during the compaction process. Remove the base plate and collar, and reverse and reassemble the mold. Apply the specified number of blows to the reversed specimen. After compaction remove the mold assembly from the pedestal, remove the collar and base plate and cool the specimen in the mold until the mold can be handled comfortably with bare hands. Asphalt treated samples do not need to be cured before testing, only cool to the touch.

3. Test Procedure

a. Assemble test equipment, base plate, mold with specimen, and standpipe.

b. Prior to conducting the test, allow a sufficient amount of water to pass through the specimen to cause all air to be expelled from the specimen. (Establish reservoir around the base with water open to atmospheric pressure.)

c. Conduct Constant-Head Permeability test and report coefficient of permeability "k". Repeat a minimum of two additional times until two runs agree reasonably well.

d. Constant-Head Permeability:

k = QL/Aht
Q = quantity of water discharged (volume)
L = length of specimen
A = cross-sectional area of specimen
h = hydraulic head (height column of water above discharge)
t = elapsed time of test
k = coefficient of permeability (length/time)
Note: For very permeable material, maintain elevation of water above the sample for 3 minutes then measure Q (flow).

## 1254 METHOD OF MEASUREMENT.

A. Untreated Compacted Aggregate Base will be paid for by one of the following:

1. Per square yard or tenth part thereof for the specified depth.

2. Per ton or tenth part thereof.

B. Portland Cement Concrete Drainable Base will be paid for by one of the following:

1. Per square yard or tenth part thereof for the specified depth.

2. Per ton or tenth part thereof.

C. Plant Mix Bituminous Drainable Base will be paid for by one of the following:

1. Per square yard or tenth part thereof for the specified depth.

2. Per ton or tenth part thereof.

1255 BASIS OF PAYMENT.

A. Untreated Compacted Aggregate Base will be paid for by one of the following:

1. Contract unit bid price.

2. Contract lump sum bid price.

B. Portland Cement Concrete Drainable Base will be paid for by one of the following:

1. Contract unit bid price.

2. Contract lump sum bid price.

C. Plant Mix Bituminous Drainable Base will be paid for by one of the following:

1. Contract unit bid price.

2. Contract lump sum bid price.

SECTION 1300 PRIME AND TACK COAT

1301 SCOPE. This section governs the requirements for all labor, equipment and materials for the application of liquid asphalt to a prepared pavement (concrete, asphaltic concrete), granular base or subbase. The type and grade of asphalt material to be used as prime or tack coat, is as specified in the special Provisions or as indicated by the plans.

1302 LIQUID ASPHALT MATERIAL. The liquid asphalt material to be used for surface preparation shall be as listed in the following table.

| **Material to be Treated** | **Application Usage** | **Type of Emulsion of Grade of Cutback** | **Application Rate (Gal/SY)** | **Application Temperature °F** | **Cure Time at 70°F** |
|---|---|---|---|---|---|
| Existing Asphalt or Concrete Surface | Tack | RC-70 | 0.05-0.10 (Gal/SY) | 150 – 225 | 1 – 6 hrs. |
| | Tack | SS-1<br>SS-1h<br>CSS-1<br>CSS-1h | 0.05-0.15 (Gal/SY) | 70 – 160 | 1 – 3 hrs. |
| Treated Base (lime, fly ash, cement) | Prime | MC-30<br>MC-70 | 0.10-0.30 (Gal/SY) | 85 – 120 | 12 – 24 hrs. |
| | Prime | SS-1<br>SS-1h<br>CSS-1<br>CSS-1h | 0.10-0.30 (Gal/SY) | 70 – 160 | 24 – 48 hrs. |
| Untreated Aggregate Base w/ Fines | Prime | MC-30<br>MC-70 | 0.10-0.30 (Gal/SY) | 85 – 120 | 12 – 24 hrs. |
| Untreated Aggregate Base w/o Fines | Prime | MC-250 | 0.20-0.50 (Gal/SY) | 85 – 120 | 12 – 24 hrs. |
| Untreated Aggregate Base | Prime | SS-1<br>SS-1h<br>CSS-1<br>CSS-1h | 0.10-0.30 (Gal/SY/in) | 70 – 160 | 24 – 48 hrs. |
| | Prime | EAP<br>PAE, or<br>PEP | 0.10-0.30 (Gal/SY) | 70 – 160 | 12 – 24 hrs. |

The asphalt material shall conform to the latest ASTM specifications for "Asphalt Cements and Liquid Asphalts." Sampling shall be in accordance with ASTM D-140.

1303 SAND COVER. Sand cover, if used, shall be any clean granular mineral meeting the following grading requirements. When tested with laboratory sieves 100 percent shall pass the No. 4 sieve and not more than two percent (2%) shall pass the No. 200 sieve. The moisture content of the sand shall not exceed three percent (3%) by weight.

1304 APPROVAL OF MATERIALS. Asphalt materials shall be approved by the Engineer prior to use in the work. The Engineer may accept a certified analysis by the refinery laboratory when a copy of the certified analysis accompanies each shipment of asphalt to the project. The Engineer will reserve the right to make check tests of the asphalt received on the job and, if the system of certified analysis proves to be unsatisfactory to the Engineer, he may discontinue this arrangement.

1305 PRESSURE DISTRIBUTOR. The distributor shall be so designed, equipped, maintained and operated so that liquid asphalt at even heat may be applied uniformly on variable widths of surface up to 15 feet at readily determined and controlled rates from 0.02 to 1.00 gallon per square yard, with uniform pressure, and with an allowable variation from any specified rate not to exceed 0.02 gallons per square yard. Distributor equipment shall include a tachometer, pressure gauges, a calibrated tank and a thermometer for measuring temperatures of tank contents. Distributors shall be equipped with a power unit for the pump, and full circulation spray bars adjustable laterally and vertically. The calibration of all distributors must be approved by the engineer, and the contractor shall furnish all equipment, material and assistance necessary if calibration is required.

1306 PREPARATION OF EXISTING SURFACE. For Tack Coats: The existing surface shall be free of dust, loose material, grease or other foreign material at the time the tack is applied. Preparation of the surface is to be performed by the contractor before the tack is applied and is subsidiary to other items in the Contract.

For Prime Coats: The surface to be primed shall be shaped to the required grade and cross section, shall be free from ruts, corrugating, segregated material or other irregularities, and shall be uniformly compacted by rolling. The surface shall be firm and slightly damp when primer is applied. Delays in priming may necessitate reprocessing or reshaping to provide a smooth compacted surface.

1307 APPLICATION OF ASPHALT MATERIAL. For Tack Coats: Asphalt emulsion shall be applied uniformly with a pressure distributor at the rate specified in the Contract, or as revised by the Engineer to be within a minimum of 0.05 and a maximum of 0.15 gallons per square yard. Water may be added to the asphalt emulsion and mixed there with in such that the original emulsion will be spread at the specified rate. The asphalt emulsion shall be heated at the time of application to a temperature in accordance with the limits provided in APWA Sec 2204.3, or as specified in the Contract Documents. The tack shall be properly cured, and the tacked surface shall be cleaned of dirt and other foreign material before the next course is placed.

The tack coat shall be applied in such a manner as two cause the least inconvenience to traffic and to permit one-way traffic without pickup or tracking of the asphalt emulsion.

For Prime Coats: Bituminous material shall be applied to the width of the section to be primed by means of a pressure distributor in a uniform, continuous spread. The sub grade shall be moistened before the prime is applied. The application rate shall be as specified in the Contract Documents or as approved by

the Engineer between 0.1 and 0.5 gallons per square yard. The primer shall be heated at the time of application to a temperature in accordance with the limits provided in Sec 2204.3, or as specified in the Contract Documents.

Care shall be taken that the application of bituminous material at overlap locations is not in excess of the specified quantity, per square yard. Building paper shall be placed over the end of the previous applications and the joining application shall start on the building paper. Building paper used shall be removed and satisfactorily disposed of. Pools of primer material remaining on the surface after the application shall be removed.

When traffic is maintained, not more than one half of the width of the section shall be treated in one application and one-way traffic will be permitted on the untreated portion of the roadbed. As soon as the bituminous material has been absorbed by the surface and will not pick up, traffic shall be routed to the treated portion and the remaining width of the section will be primed. The primer shall be properly cured, and the primed surface shall be cleaned of dirt and surplus sand before the next course is placed.

1308 APPLICATION OF SAND COVER. If the asphalt material is not completely cured within the maximum specified curing time, sufficient sand shall be spread over the surface with a mechanical spreader to blot up the excess asphalt. The rate of application shall be specified or approved by the Engineer. Prior to placing an asphalt paving course, all loose sand shall be swept from the primed or tacked surface.

# SECTION 1400 ASPHALTIC CONCRETE SURFACE AND BASE

1401 SCOPE. This work shall consist of a bituminous mixture placed, spread, and compacted as shown on the plans, or as directed by the Engineer. The Contractor shall be responsible for Quality Control (QC) of the bituminous mixture, including the design and control of the quality of the material incorporated into the project. The Engineer may perform Quality Assurance (QA), including testing, at the Owner's discretion, to assure the quality of the material incorporated into the project.

1402 MATERIALS. All material shall comply with the current version, at time of bid letting, of the Missouri Department of Transportation (MoDOT) Standard Specifications, Section 401, Plant Mix Bituminous Base and Asphalt, except as specifically noted herein. All materials incorporated into any mixtures shall be current MoDOT approved products and all aggregates must come from currently approved MoDOT sources and/or ledges. Sections of the MoDOT Specifications numbers referenced in this Specification are valid to MoDOT Specifications numbers in place at the time this Specification was published.

A. Required Mixtures. Required mixtures shall be located on the plans. When not designated, Surface Mixture shall only be BP-1 or BP-2. The grade of asphalt binder for all mixes shall be PG 64-22 or as otherwise specified in the Contract Documents. Use of the approved Mo DOT Section 403 Superpave mixture may be allowed with approval from the Engineer. Use of Mo DOT Section 403 mixtures will not be allowed for use on residential streets. If Mo DOT Section 403 mixtures are used, volumetric testing tolerance limits will be adjusted by the Engineer as applicable.

B. Reclaimed Asphalt and Asphalt Shingles. A maximum of 20% virgin effective binder replacement may be used in mixtures. Reclaimed Asphalt Shingles (RAS) may be used up to 3% total in base mixtures only.

1403 JOB MIX FORMULA. All job mixtures to be used on any Public Improvement Project shall be a currently approved MoDOT mix design. All materials for these mixtures must meet current MoDOT requirements, except as modified by this Specification, as applicable, including maximum RAS and recycled material contents as listed in Section 1402. The Contractor is responsible for attaining MoDOT approval on all mixes prior to submittal to the City for approval and use. Commercial mix designs or BP-3 may be considered for use on small repair areas, parking lots, or other miscellaneous uses as approved in writing by the Engineer.

A. A current approved MoDOT mix design shall be provided to the Engineer a minimum of 10 working days prior to placing any mixture on the project. No mixture shall be placed until the mix design has been accepted by the Engineer in writing. When unsatisfactory results occur, or should a source of material be changed, a new job mix formula may be required. If requested, the Contractor shall provide the Engineer with data from MoDOT for source approvals and mix designs.

1404 GRADATION AND DELETERIOUS CONTENT CONTROL. In producing mixtures for the project, the plant shall be operated such that no intentional deviations from the job-mix formula are made.

When daily production exceeds 1000 tons, the Contractor shall determine daily at a minimum, the gradation on the aggregate reclaimed from the Recycled Asphalt Products (RAP) by either extraction or binder ignition. The gradation results shall be used to determine the daily Specification compliance for the combined gradation. Mixtures as produced shall be subject to the following tolerances and control.

The combined gradation shall meet the gradation requirements for each respective mixture as required by MoDOT's Specifications for compositions of mixtures for the following sieves:

The largest sieve size for which any material is retained in the Job Mix Formula, the No. 8 sieve, and the No. 200 sieve. For BP-3 mixtures, the No. 16 sieve will be used in lieu of the No. 8 sieve.

As

The deleterious content of the material retained on the No. 4 sieve shall not exceed the limits specified as follows:

| **Deleterious Material** | **Percent By Weight** |
|---|---|
| Deleterious Rock | 8.0 |
| Shale | 1.0 |
| Other Foreign Material | 0.5 |

If the Plasticity Index (PI) of any fraction exceeds that of the material approved for the mix design, additional testing may be required as determined by the Engineer.

The quantity of asphalt binder introduced into the mixer shall be the quantity specified in the job-mix formula. No changes shall be made to the quantity of asphalt binder without written approval from the Engineer. The quantity of asphalt binder determined by tests on the final mixture shall not vary by more than ± 0.3% from the job-mix formula.

A. Sample Location**.** The gradations of the total aggregate will be determined from samples taken from the hot bins on batch-type plants or continuous mixing plants or from the composite cold feed belt on drum mix plants. The deleterious content of the total aggregate shall be determined from samples taken from the composite cold feed belt. When required, samples for plasticity index shall be taken from the stockpile. The RAP shall be sampled from the RAP feeding system on the asphalt plant.

B. Moisture Content**.** The bituminous mixture, when sampled and tested in accordance with AASHTO T 329, shall contain no more than 0.5% moisture by weight of the mixture.

C. Contamination**.** The bituminous mixture shall not be contaminated with deleterious agents such as unburned fuel, objectionable fuel residue or any other material not inherent in the job mix formula.

1405 LABORATORY. The laboratory shall contain certified and calibrated equipment to perform all testing. The laboratory may be used at any time by the City of Branson or their designees to perform testing.

1406 CONSTRUCTION REQUIREMENTS.

A. Weather Limitations**.** Bituminous mixtures shall not be placed on any wet surface or frozen surface. The temperature of the surface on which the mixture is to be placed, shall be a minimum of 35°F prior to paving operations commencing. No paving will be permitted with an ambient air temperature under 45°F. If the National Weather Service forecasted temperatures for the respective area fall below 45°F at any time during the paving period, the Contractor shall gain approval from the Inspector before paving begins. Temperatures shall be obtained in accordance with MoDOT Test Method TM 20.

B. Bituminous Mixing Plant**.** The plant shall be specifically designed for satisfactorily heating, drying, and mixing bituminous mixtures in accordance with Section 404 of the MoDOT Standard Specifications for Highway Construction. All information regarding calibrations, verifications, or other requirements shall be provided to the Engineer upon request. All asphalt plant tickets shall be provided to the Inspector in the field and shall provide the following information at minimum:

1. Gross and tare weights
2. Current date and time
3. Mix type
4. Unique ticket number
5. City Public Works (PW) number, FHWA Number (when applicable), Street, and County

C. Hauling Equipment**.** Trucks used for hauling bituminous mixtures shall have tight, clean, smooth, metal beds that have been thinly coated with an approved bituminous mixture release agent. Use of diesel fuel or other detrimental products will not be permitted. Each truck shall have a cover of canvas or other suitable material to protect mixture from weather.

D. Spreading**.** The base course or preceding course or layer shall be cleaned of all dirt, packed soil or any other foreign matter prior to tack coat application and spreading the bituminous mixture. The mixture shall be spread in the number of layers and in the quantity required to obtain the compacted thickness and cross section shown on the plans. When placing multiple layers with varying thicknesses, the thicker layer shall be placed first. The compacted thickness of a single layer of bituminous pavement mixture shall be no more than 2 inches for BP-1, BP-2, and BP-3 mixtures and 4 inches for Bituminous Base. Maximum thickness may be changed with written approval from the Engineer.

E. Irregularities**.** The mixture shall be spread without tearing the surface and struck off such that the surface is smooth and true to cross section, free from all irregularities, and of uniform density throughout. Care shall be used in handling the mixture to avoid segregation. Areas of segregated mixture shall be removed and replaced with a suitable mixture at the Contractor's expense. The outside edge alignment shall be uniform. Irregularities shall be corrected by adding or removing mixture before compacting. Segregated mixtures shall be removed and replaced to the limits determined by the Engineer.

F. Leveling Course**.** If required by the contract, a leveling course consisting of a layer of variable thickness shall be spread to the desired grade and cross section to eliminate irregularities in the existing surface. Spot-leveling operations over small areas, with feather-edging at high points and ends of spot areas, may be required prior to placing the leveling course. Rigid control of the

placement thickness of the leveling course will be required. The mixture shall be free from segregation.

G. Base Widening**.** The specified total thickness of base widening shall be completed to the adjacent traveled way elevation as shown on the plans. Additional thickness of base widening may be placed as required prior to cold milling, at the Contractor's expense, and shall subsequently be cold milled to the same elevation as the traveled way, if conducive to expedite operations. On base-widening work, a succeeding layer of bituminous mixture may be placed the same day as the previous layer, if it can be shown that the desired results are being obtained. On small areas, and on areas that are inaccessible to mechanical spreading and finishing equipment, the mixture may be spread and finished by hand methods if permitted by the Engineer.

H. Edge Differential**.** For roadways constructed under traffic, no pavement edge differential shall be left in place for more than 7 days, unless approved by the Engineer. A pavement edge differential greater than 2 inches for any longitudinal joint within 10 feet of a travel way will not be allowed to be left in place. If operations result in traffic being exposed to an edge differential greater than 2 inches and within 10 feet of the travel way, the Contractor shall place edge treatment in accordance with the most recent version of Section 619 of the MoDOT Standard Specifications for Highway Construction. Any work required to comply with edge differential requirements is considered incidental and no payment will be made.

I. Joints**.** The minimum unconfined joint density of all traveled way pavement within 6 inches of a longitudinal joint, including the pavement on the traveled way side of the shoulder joint, shall be no less than 2.0% below the specified density. Pay adjustments due to longitudinal joint density shall apply to the full width of the lane paved and shall apply to the day's production from which the cores are obtained. Transverse joints shall be formed by cutting back on the previous run to expose the full depth of the layer. Transverse joints in adjacent lanes shall be offset a minimum of 10 feet. When a transverse vertical edge is to be left in place and opened to traffic, a temporary depth transition shall be constructed as approved by the Engineer. The longitudinal joints in one layer shall offset those in the layer immediately below by approximately 6 inches. The joints in the final surface layer shall be at the lane lines of the traveled way, except that the placement width shall be adjusted such that pavement marking shall not fall on a longitudinal joint. Each side of the joint shall be flush and along true lines.

J. Pavement Thickness**.** It is the intent of these Specifications that the asphalt shall be constructed strictly in accordance with the thickness shown on the plans for each bituminous course that comprises the overall pavement thickness. The thickness of an independent bituminous base or surface course will be measured and determined by the average caliper measurement of the density cores taken from the lift(s) comprising the respective asphalt course. If individual base or surface course varies from plan thickness by more than a ½ inch, the Engineer may require corrections or additional testing as applicable.

K. Pavement Thickness – Full Depth**.** After all bituminous courses have been placed in multi-lift construction, full depth cores may be taken at random locations determined by the Engineer. If the measurement of any core is deficient by a ½ inch from plan thickness, additional cores will be taken at 25-foot intervals parallel to centerline ahead and back of the affected location until

the extent of the deficiency has been determined. It will be assumed that each core is representative of the total combined thickness for a distance extending ½ the distance to the next core, measured along centerline, or in the case of a beginning or ending core, the distance extending to the end of pavement section. In those areas of deficient thickness in excess of a ½ inch that cannot be corrected without affecting the plan crown and grade, the Engineer has the option of requiring that defective pavement will be removed and replaced with a bituminous course of proper thickness or leaving in place and requiring the following deductions in payment.

| Deficiency in Thickness | Deduction Percent of Contract Unit Price |
|---|---|
| 0 inch to ½ inch | None |
| Over ½ inch and not over ¾ inch | 50 |
| Over ¾ inch and not over 1 inch | 100 |

No additional compensation will be allowed the Contractor for any plant mix bituminous pavement constructed in excess of the thickness requirements. The surface from which the cores have been taken shall be restored by the Contractor within 48 hours using a non-shrink grout acceptable to the Engineer.

If removal of the pavement is required, the Contractor will be required to remove the pavement and to replace it with one of satisfactory quality and thickness which, when accepted, will be included in the pay quantities. No payment will be made for any costs incurred in the removal of the pavement deficient in thickness or for the original pavement placement.

## 1407 QUALITY CONTROL AND TESTING

A. Quality Control Plan and Personnel**.** The Contractor shall maintain equipment and qualified personnel to perform Quality Control (QC) field inspection and sampling and testing in accordance with this Specification. All personnel performing testing on any Public Improvement Project shall have proper MoDOT or Technician Certifications as approved by the Engineer. The Contractor shall submit a Quality Control Plan to the Engineer for approval 10 business days prior to asphalt operations beginning. Asphalt operations shall not begin until the Engineer has accepted the Quality Control Plan. The Quality Control Plan shall at a minimum provide the following information:

1. Asphalt plant location and access and/or safety guidelines including storage location and access to split samples.

2. Contact information for QC staff and preferred method of communication of results • QC staff current Certifications.
3. Action Plan for when mixture falls outside tolerances during construction. Action Plan shall outline the specific process for testing if mixture falls outside the tolerance range including timeline, communication plan with contact information, and other details in accordance with this Specification.

4. Calibration methods of testing equipment used in the provided laboratory.

5. Coring procedures and core patching material.

An onsite pre-paving meeting with City and Contractor's staff shall be required to discuss communication channels, laydown operations, testing methods, and coring procedures before any paving operations begin. The Contractor shall coordinate the pre-paving meeting with the project Inspector.

B. Pavement Testing**.** During construction, the Engineer will designate as many tests as necessary to ensure that the course being constructed is of proper thickness, composition and density. Any test required, or performed by the Engineer may be used to determine acceptance of the asphalt mixture or determine removal limits. Any test affecting the amount of payment due to the Contractor for material left in place shall be located and/or performed from random sampling methods as determined by the Engineer.

1. Loose Mixture Testing**.** The Contractor shall test once per day for the gradation and deleterious content of the combined aggregate. The Contractor shall, at minimum, test once daily the asphalt mixture for the Asphalt Content, Voids (VA), Voids in Mineral Aggregate (VMA), Theoretical Maximum SG of Mixture (Gmm field). If daily production exceeds 3000 tons, additional tests shall be taken for each 3000 tons of production or portion thereof. The Contractor shall coordinate daily with the Inspector the location of the official, field sample for loose mixture testing. If no agreement can be made, the Inspector will require loose mixture samples from random numbers provided to the Contractor. If RAP is used and AASHTO T 308 is used to determine the asphalt content, the binder ignition oven shall be calibrated in accordance with MoDOT Test Method TM 77. At the Engineer's discretion, testing may be waived when production does not exceed 250 tons per day. The Contractor shall certify the proper proportions of a previously proven mixture were used.

2. Density Testing**.** Density of the roadway shall be sampled daily by taking field cores for each 500 tons produced daily, or portion of thereof, obtained by the Contractor at random locations selected by the Engineer. For full depth, new construction only, an unconfined joint density sample shall consist of cores taken from alternating sides of the lane at the same longitudinal location as the roadway cores where unconfined joints exist. The average of daily Field Gmm test(s) shall be used in the calculation for the in-place density. Four-inch diameter core samples shall be taken the full depth of the layer to be tested. The Contractor shall restore the surface from which samples have been taken immediately with the mixture under production or an approved non-shrink grout. All cores shall be taken in the presence of the Inspector. The Inspector reserves the right to measure, label, and/or maintain possession of cores until such time the Contractor will determine the density in the laboratory.

3. Retained Samples**.** One half of the Contractor's sample for gradation, deleterious content, plasticity index, and asphalt content and all cores shall be retained for the Engineer. The Contractor shall retain the samples 14 days after testing occurred or as directed by the Engineer.

4. Test and Frequencies**.**

| Tested Property | Test Method | Contractor Testing Frequency |
|---|---|---|
| Mat Density (% of Field Gmm) | AASHTO T166 | 1 per every 500 tons of daily production or portion thereof |
| Unconfined Joint Density (% of Field Gmm) | AASHTO T166 | 1 per every 500 tons daily production or portion thereof (new construction only) |
| Gradation & Deleterious Content | AASHTO T27, T11 | 1 per day when production exceeds 1000 tons |
| Asphalt Content | AASHTO T164, T287, T308 | 1 per day or every 3000 tons of daily production |
| Asphalt Content of RAP | AASHTO T164 | 1 per day when production exceeds 1000 tons |
| VMA @ Ndes | AASHTO T312 | 1 per day or every 3000 tons of daily production |
| Voids (VA) @ Ndes | AASHTO T312 | 1 per day or every 3000 tons of daily production |
| Theoretical Maximum SG of Mixture (Gmm) | AASHTO T209 | 1 per day or every 3000 tons of daily production |

a. Loose Mixture Properties**.** If Voids, VMA, or Asphalt Content test result falls outside of the Specification tolerances as listed in 11.8.2.5.1.1, a review or adjustment of the plant settings and production shall be made and another sample shall be immediately taken and changes communicated in accordance with the Action Plan as submitted in the Quality Control Plan. This second test may be taken at the location of the plant as a truck sample. If the second test falls outside of the Specification tolerances as listed in 11.8.2.5.1.1, production shall immediately cease until the mixture can be brought back into Specification. Plant production for the following day shall not resume until the mixture is brought back into Specification and written approval is given by the Engineer to continue production.

i. Loose Mixture Payment Adjustments and Removal Limits**.** Payment for mixture placed at or below the required minimum tolerances will be adjusted or removed as follows:

| Test Property | Tolerance Limit/Action Plan | Deduction | Removal Limit |
|---|---|---|---|
| Asphalt Content | ±0.3%<br>From Job Mix Formula | See Chapter 2 Article 14.02.C | See Chapter 2 Article 13 |
| Vma @ Ndes | -1.0% to +2.0%<br>From Job Mix Formula | See Chapter 2 Article 14.02.C | See Chapter 2 Article 13 |
| Va @ Ndes | Below 2.5% | See Chapter 2 Article 14.02.C | Below 2.0% |

**Contractor shall notify the Inspector immediately of all tests that fall outside the Specification tolerances in accordance with approved Action Plan as submitted in the QC Plan.**

All volumetric targets are based on a mix design of target Voids of 3.5%. If a different mix design is approved with different target Voids or VMA, the targets will be adjusted by the Engineer.

5. Density**.** The compacted mixture shall have a minimum density of 92.0 % determined by the specific gravity method. The Contractor shall calculate the average Gmm from material obtained behind the paver for the test(s) representing that day's production. An average of all cores tested that day, including unconfined joint cores with 2% added to the original results of the joint cores only, shall determine the density representing that day's production. If the average test results for the day's production results in a test outside of the Specification tolerances and a total of 4 cores were not taken, the Engineer will provide random sample locations to cut additional cores until 4 total cores are taken to determine the density representing the day's production. If the average of the minimum 4 cores taken falls outside the Specifications, reduction in payment will be made for all mixture placed that day in accordance with the chart in Section 1407.B.6.a. When any individual core shows an effective density of less than 89.5%, additional methods shall be used to determine the limits of the failure. The Engineer shall determine methods to identify the failing area. Areas of failing density shall be removed and replaced at the Contractor's expense.

    a. Density Adjustment**.** Payment for mixture placed at or below the required minimum density will be adjusted as follows. Joint cores only apply to cores within 6 inches of unconfined joints and shall have 2% added to the test result for use of average results as listed below:

| Mainline Density (from Field Gmm) | Percent of Contract Unit Price |
|---|---|
| 92 or above | 100% |
| 91.9 to 91.5, inclusive | 97% |
| 91.4 to 91.0, inclusive | 94% |
| 90.9 to 90.5, inclusive | 90% |
| 90.4 to 90.0, inclusive | 85% |
| Below 90.0 | Remove and Replace |

6. Quality Assurance**.** Tests may be performed by a certified City representative (QA) or their designee at rates determined by the Engineer. A favorable QA comparison of a QC split sample will be defined as listed in Section 1407.B.7.a of these Specifications.

   a. Unfavorable Comparison. After determining an unfavorable loose mixture comparison, all loose mixture samples taken at the paver shall provide enough material to complete 2 complete tests until the source of the unfavorable comparison is formally resolved. When density results do not compare, QA cores shall be taken at all QC core locations until such time the discrepancy in tests results is formally resolved. If QC and QA results do not compare favorably, but both tests result in no change in payment or acceptance, the QC and QA staff shall coordinate running a split sample including weighing density cores to identify any issues causing the discrepancies. If the QA results of a split sample indicate an unfavorable comparison and any of the QA results fall outside of the Specification limits and/or within the removal limits, the QC results will be considered disputed and will be reevaluated as per Section 1407.B.7.a.i and 1407.B.7.a.ii as applicable.

   For aggregate, if the results of the split sample are not within 5% on all sieves above the No. 200, 2% on the No. 200, within the Specification ranges on the deleterious content, and within 2 percentage points on the plasticity index from the Contractor's results, another split sample will be taken jointly with the Contractor and tested. If the second test results do not compare within the Specification tolerances adjustment shall be made and a third test performed. If the third test fails, the Engineer may require production to cease until corrections are made.

| Test | Specification Range | Favorable QA Comparison * |
|---|---|---|
| Mat Density<br>(% of Field Gmm) | 92% or above | ±0.5% from adjacent QC core |
| Unconfined Joint Density<br>(% of Field Gmm) | 90% or above | ±0.5% from adjacent QC core |
| Gradation & Deleterious Content | See Section 1404 | See Section 1404 |
| Asphalt Content | ±0.3%<br>From Job Mix Formula | ±0.25% From QC Split |
| VMA @ Ndes | 1.0% to +2.0%<br>From Job Mix Formula | ±0.25% From QC Split |
| VA @ Ndes | ±1.0% From Job Mix Formula | ±0.25% From QC Split |

   i. Disputed Loose Mixture QC/QA results shall be remediated for each day's production in the order as follows:

   Both QC and QA shall perform a respective test in the presence of each other at the Contractor's or QA laboratories as applicable. Both QC and QA staff shall determine if any errors may have been made on the disputed

test results and make adjustments accordingly.

If no agreement can be made and the QC or QA test results would result in removal and/or reduction in pay, dispute resolution process shall commence in accordance with 1407.C of the Specifications.

ii. Disputed Density results shall be remediated for each day's production in the order as follows:

If the locations are still accessible and no additional lifts have been placed over the QC core locations, the Contractor will cut QA cores at the locations of the disputed QC cores. QA will run all cores and correlate the average of the QA cores using the Gmm field determined from the QA split sample for that day's production with the original QC density results. If the QA average density results fall within the tolerances in section 1407.B.7.a. of these Specifications, then no further action is necessary, and the QC results will be used.

If the prior locations of the QC cores have had additional lifts placed over them or favorable comparison is not achieved in step 1 above, an additional analysis will occur as follows: The Engineer will determine a minimum of 4 random locations to cut additional density cores. The Contractor will cut cores at these locations for the representative lift(s) in question and determine the average density based on the field Gmm from the remaining split sample. If there is not sufficient material from the split sample to determine a field Gmm, material broken down from the cut cores will be used. All tests will be done in the presence of a City representative and test samples shall be secured as instructed by the City representative. The results of this final test will determine the final pay and acceptance of the day's production.

C. Dispute Resolution**.** When there are significant discrepancies between the Engineer's and the Contractor's tests results and no agreement or determination can be made based on the Specifications as outlined herein, dispute resolution procedures, as provided in this Specification, will be used.

1. Cease Work**.** The Contractor's operations may be required to cease, as determined solely by the Engineer, until the dispute is resolved if the test results indicate the mixture is subject to failure.

2. Third Party Testing**.** The first step in dispute resolution will be to identify differences in procedures and correcting inappropriate procedures before moving to third party testing. If that does not resolve the dispute, either the Contractor or the Engineer may request third party involvement. The third-party tests methods and results will be considered final and used by the Engineer for determination of defective material as necessary for removal and/or for pay reduction.

3. Third Party Payment**.** The Contractor shall be responsible for the cost associated with any third-party testing if the final result indicates the Engineer's test results were correct. Likewise, the City will be responsible for any cost associated with the third-party testing when the final result indicates the Contractor's results were correct.

4. Other Adjustments**.** The Contractor shall not be entitled to any additional payment for costs incurred due to use of the dispute resolution procedures such as, but not limited to, those for delay, cessation of operations, costs to subcontractors, etc.

D. Surface Smoothness**.** The finish of the pavement surface shall be substantially free from waves or irregularities, shall be true to the established crown and grade, and shall be in accordance with Chapter 9.1.3.12. Diamond grinding bumps shall only be permitted for 1.5 inch or greater single lift surface.

E. Defective Mixture**.** Any mixture showing an excess of bituminous material or that becomes loose and broken, mixed with dirt, or is in any way defective, shall be removed and replaced with a satisfactory mixture, at the Contractor's expense, which shall be immediately compacted to conform with the surrounding area.

F. Method of Measurement**.**

1. Asphalt Pavement**.** Measurement of asphalt pavement will be made for payment to the nearest 1⁄10 ton for the total tonnage of material accepted. The weight of the mixture will be determined by weighing each truck load on scales in accordance with Section 310 of the MoDOT Standard Specifications.

2. Asphalt Surface Course**.** Measurement of asphalt surface course will be made for payment to the nearest square yard of the final driving surface area complete, in place, and accepted.

3. Asphalt Base Course**.** Measurement of asphalt base course will be made for payment to the nearest square yard complete, in place, and accepted. Measurement will be based on the final driving surface area and will not include any additional quantity needed to construct the 1:1 slope.

4. Aggregate Base**.** Measurement of aggregate base will be made for payment to the nearest square yard complete, in place, and accepted. Measurement will be based on the final driving surface area of the pavement and will not include any additional quantity required.

5. Basis of Payment**.** The accepted quantities of asphalt will be paid for based on accepted plant tickets compiled in the field. The accepted quantities of asphalt surface course, asphalt base course, and aggregate base will be paid for based on field measurements completed by the Inspector at the unit price bid for the items stated in the contract. Payment shall include all incidental items necessary to complete the work.

Payments will be made under:

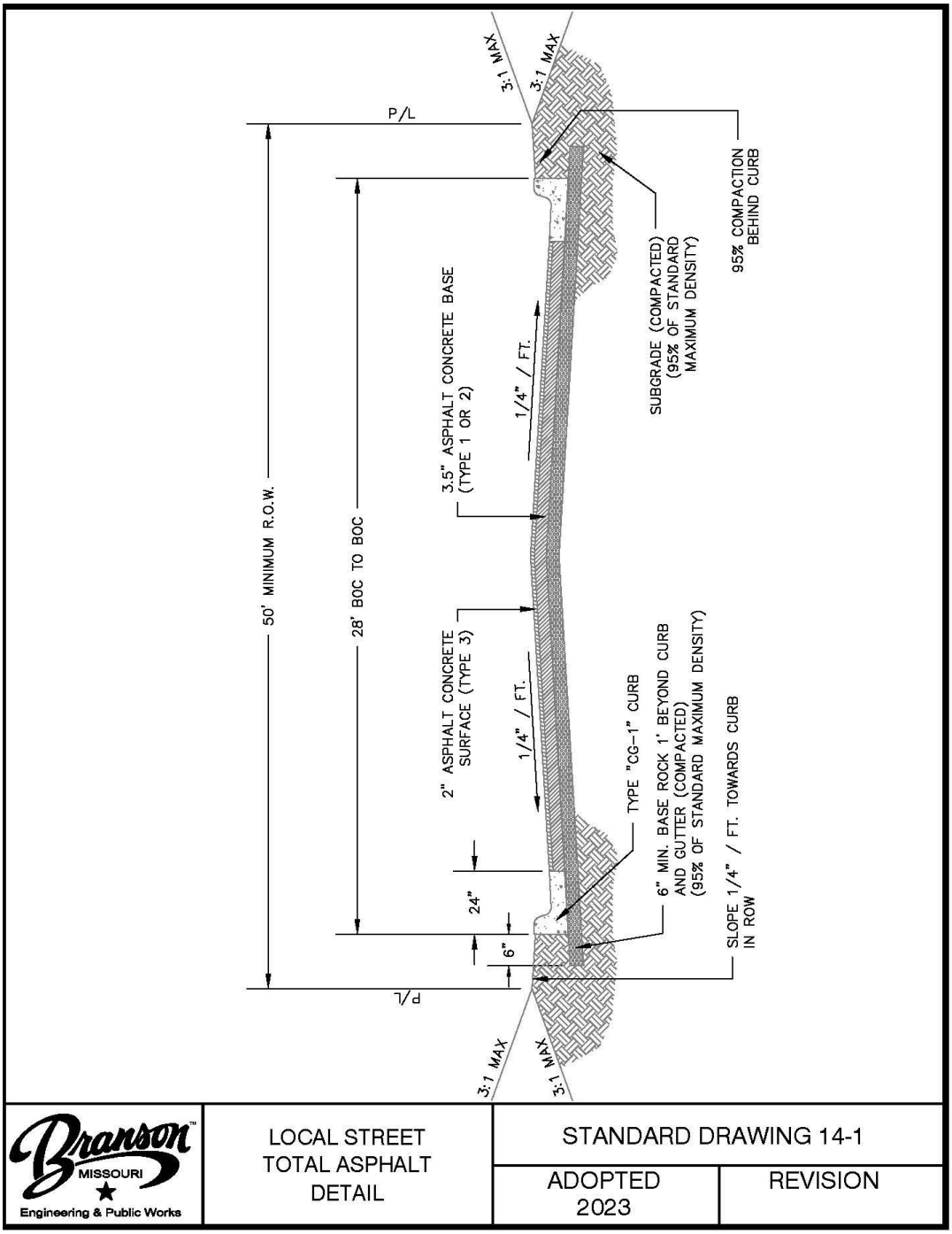
| | |
|---|---|
| Item COS-11.8.11.5.1 | Asphalt Pavement - per ton |
| Item COS-11.8.11.5.2.0* | Asphalt Surface Course - per square yard Item |
| COS-11.8.11.5.3 .0* | Asphalt Base Course - per square yard |
| COS-11.8.11.5.4.0* | Aggregate Base - per square yard |

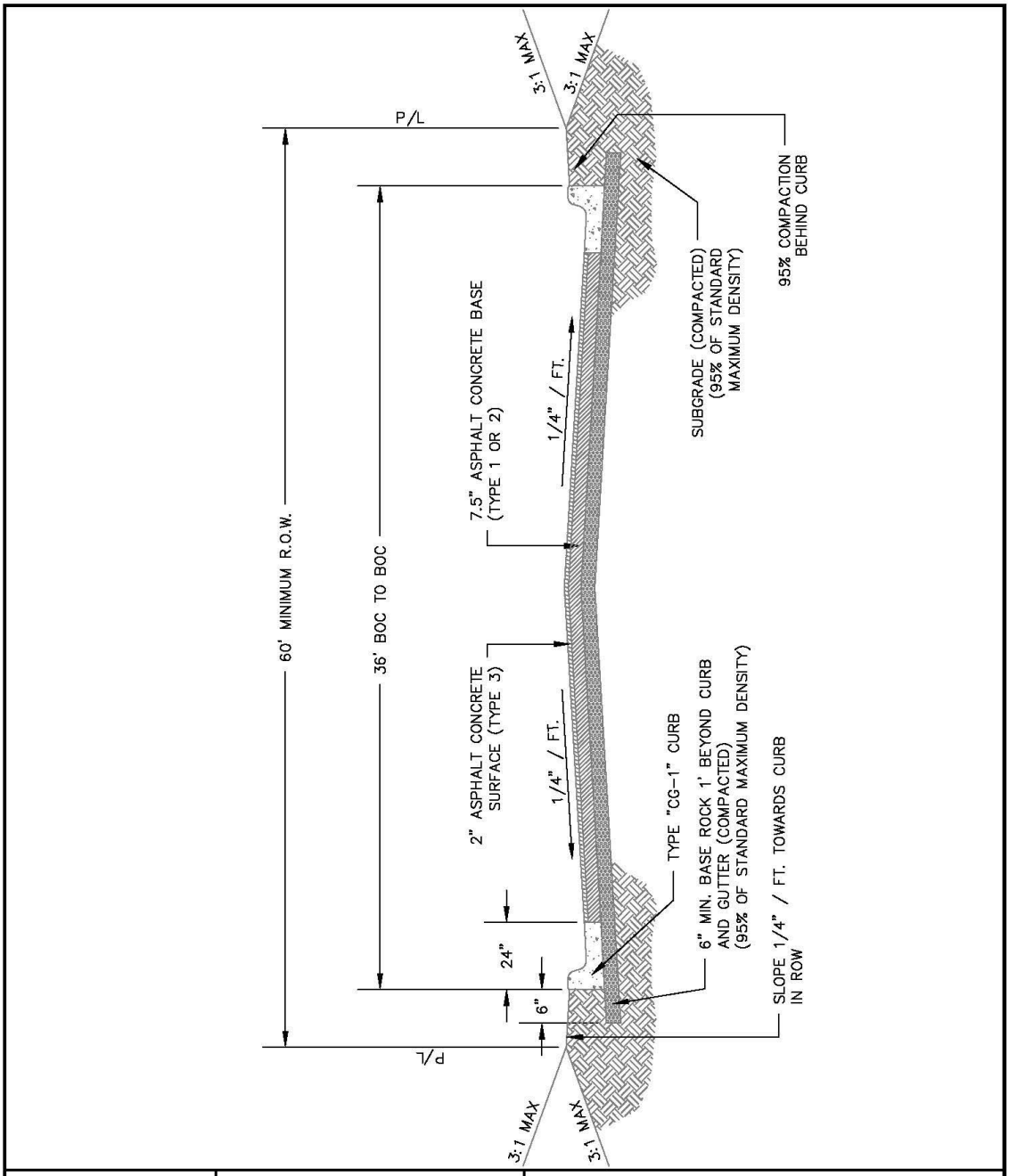
* Where 0 represents the thickness in inches

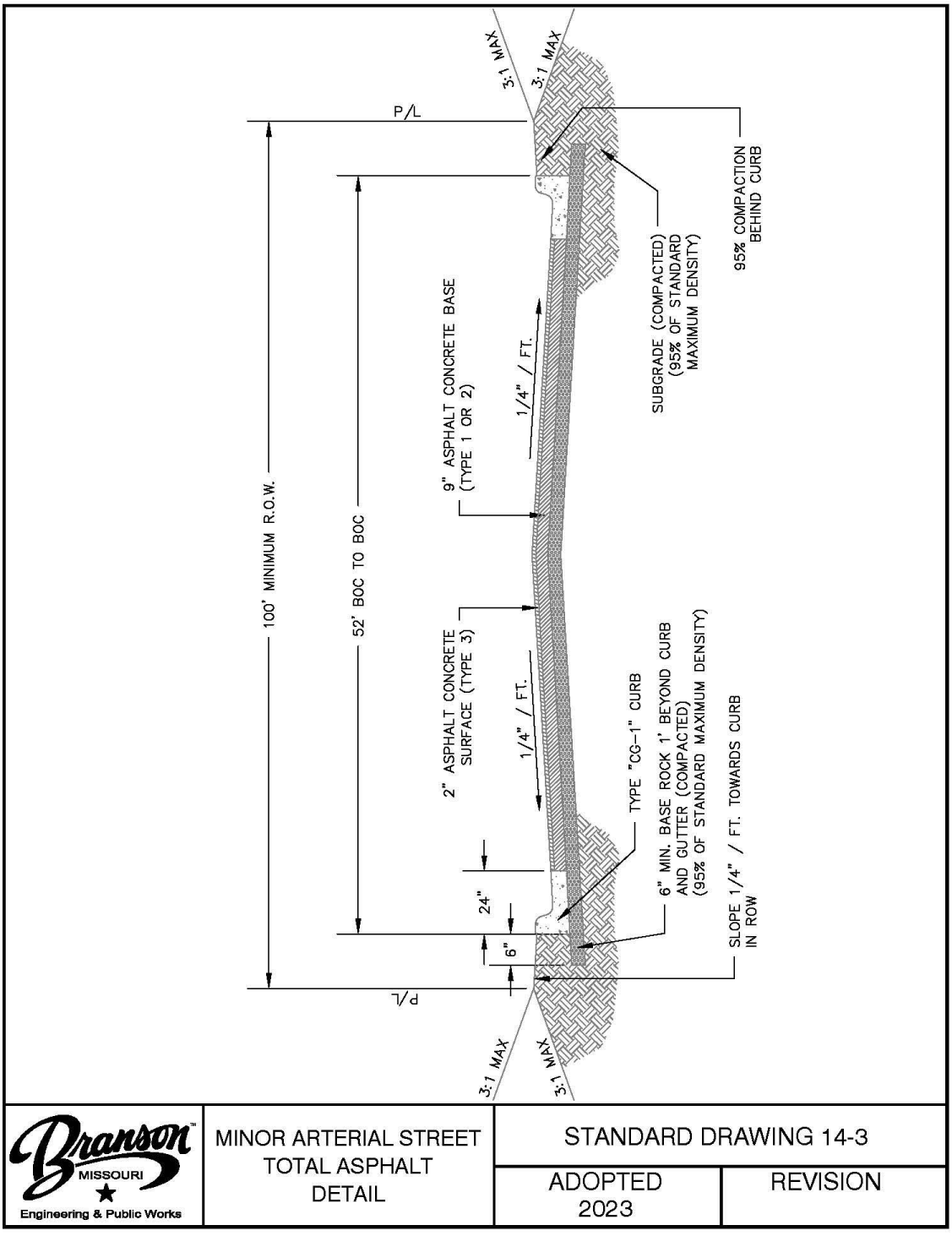
G. Method of Measurement and Payment, Tack Coat

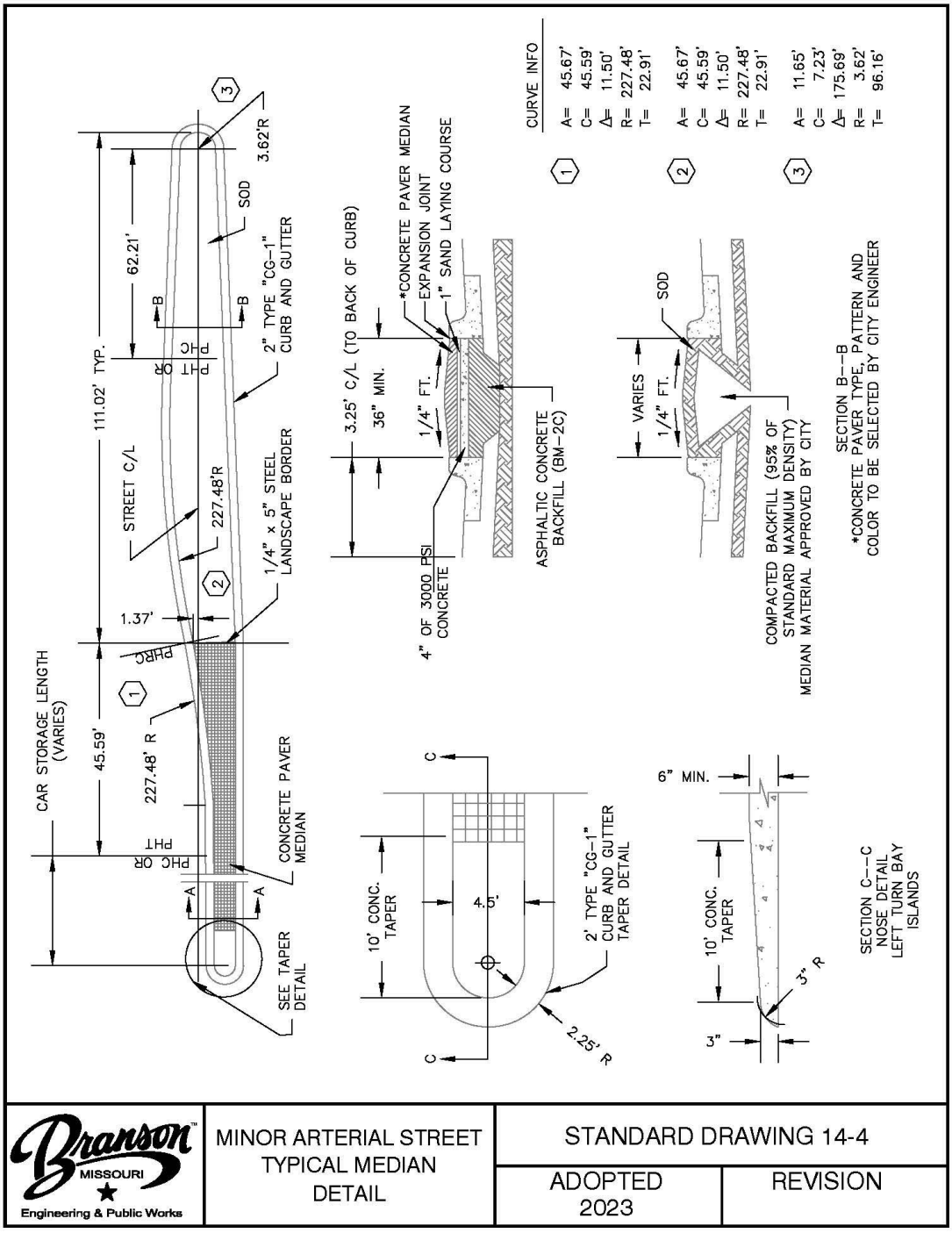
1. Method of Measurement Tack Coat**.** Measurement of Tack Coat will not be made.

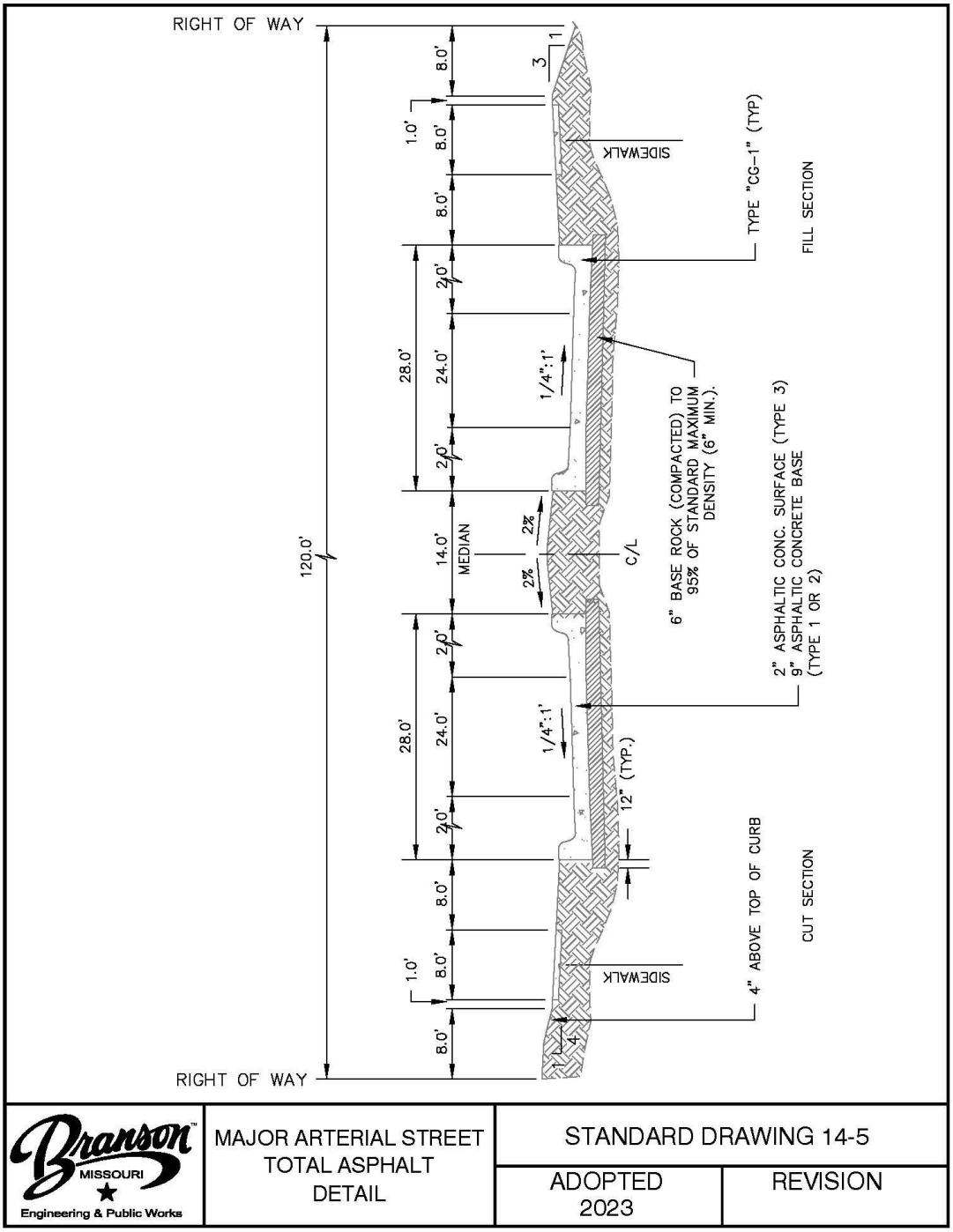
2. Basis of Payment Tack Coat**.** No payment will be made for Tack Coat and it will be considered incidental to other items in the contract.

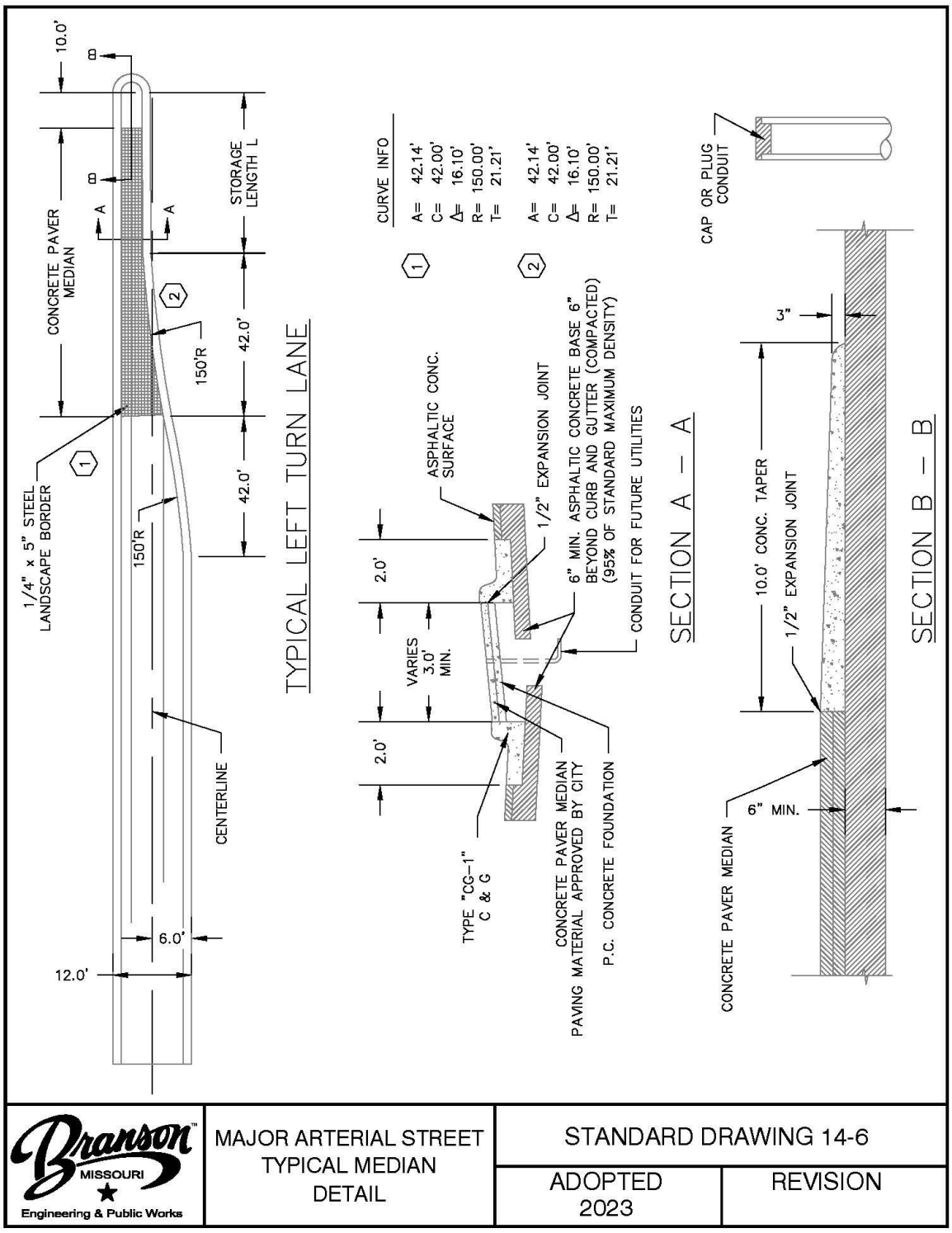

3:1 MAX
3:1 MAX
P/L
95% COMPACTION BEHIND CURB
SUBGRADE (COMPACTED) (95% OF STANDARD MAXIMUM DENSITY)
1/4" / FT.
3.5" ASPHALT CONCRETE BASE (TYPE 1 OR 2)
50' MINIMUM R.O.W.
28' BOC TO BOC
2" ASPHALT CONCRETE SURFACE (TYPE 3)
1/4" / FT.
TYPE "CG-1" CURB
6" MIN. BASE ROCK 1' BEYOND CURB AND GUTTER (COMPACTED) (95% OF STANDARD MAXIMUM DENSITY)
24"
6"
SLOPE 1/4" / FT. TOWARDS CURB IN ROW
P/L
3:1 MAX
3:1 MAX
Branson MISSOURI
Engineering & Public Works
LOCAL STREET TOTAL ASPHALT DETAIL
STANDARD DRAWING 14-1
ADOPTED 2023
REVISION

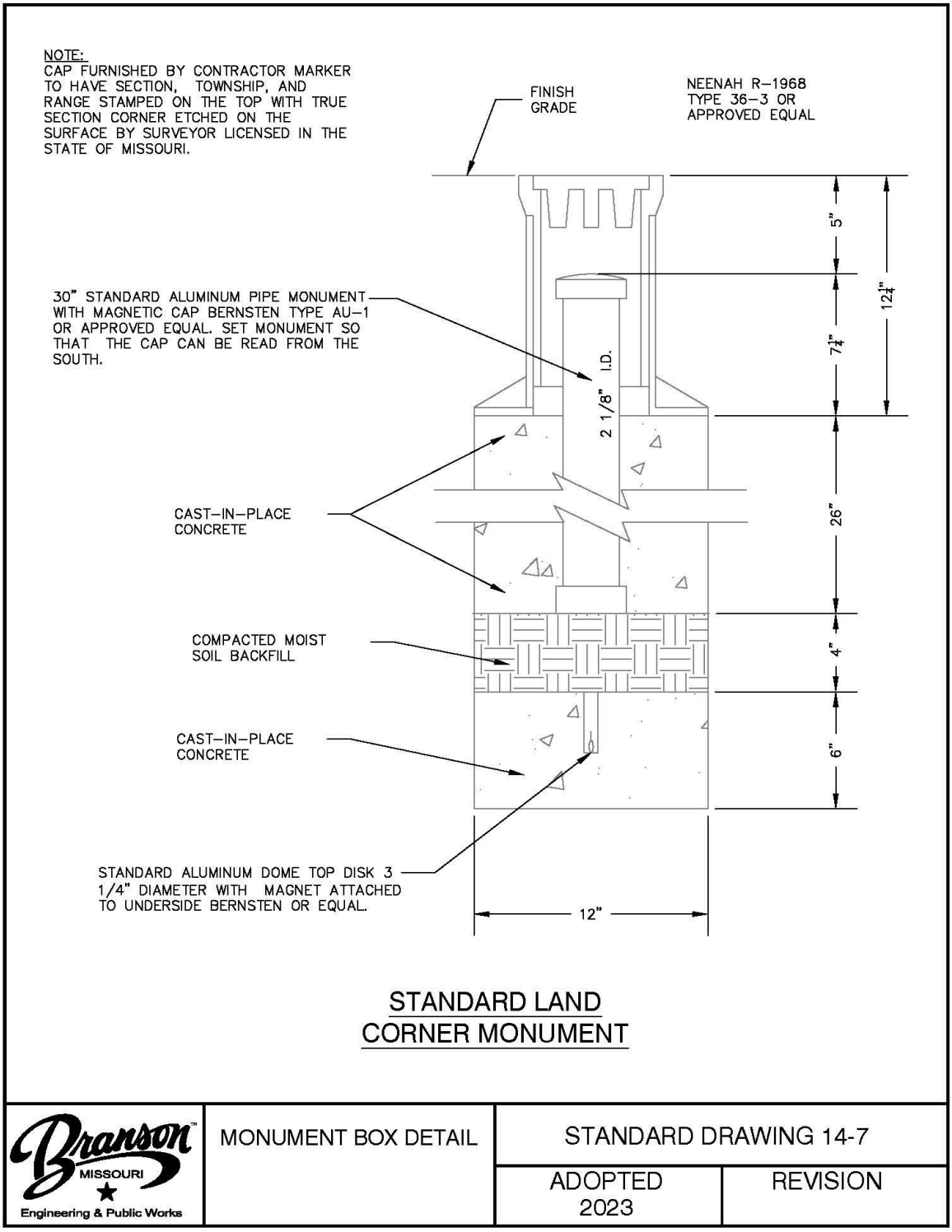

3:1 MAX
3:1 MAX
P/L
95% COMPACTION BEHIND CURB
SUBGRADE (COMPACTED) (95% OF STANDARD MAXIMUM DENSITY)
1/4" / FT.
7.5" ASPHALT CONCRETE BASE (TYPE 1 OR 2)
60' MINIMUM R.O.W.
36' BOC TO BOC
2" ASPHALT CONCRETE SURFACE (TYPE 3)
1/4" / FT.
TYPE "CG-1" CURB
6" MIN. BASE ROCK 1' BEYOND CURB AND GUTTER (COMPACTED) (95% OF STANDARD MAXIMUM DENSITY)
24"
6"
SLOPE 1/4" / FT. TOWARDS CURB IN ROW
P/L
3:1 MAX
3:1 MAX
Branson MISSOURI
Engineering & Public Works
COLLECTOR/COMMERCIAL STREET TOTAL ASPHALT DETAIL
STANDARD DRAWING 14-2
ADOPTED 2023
REVISION

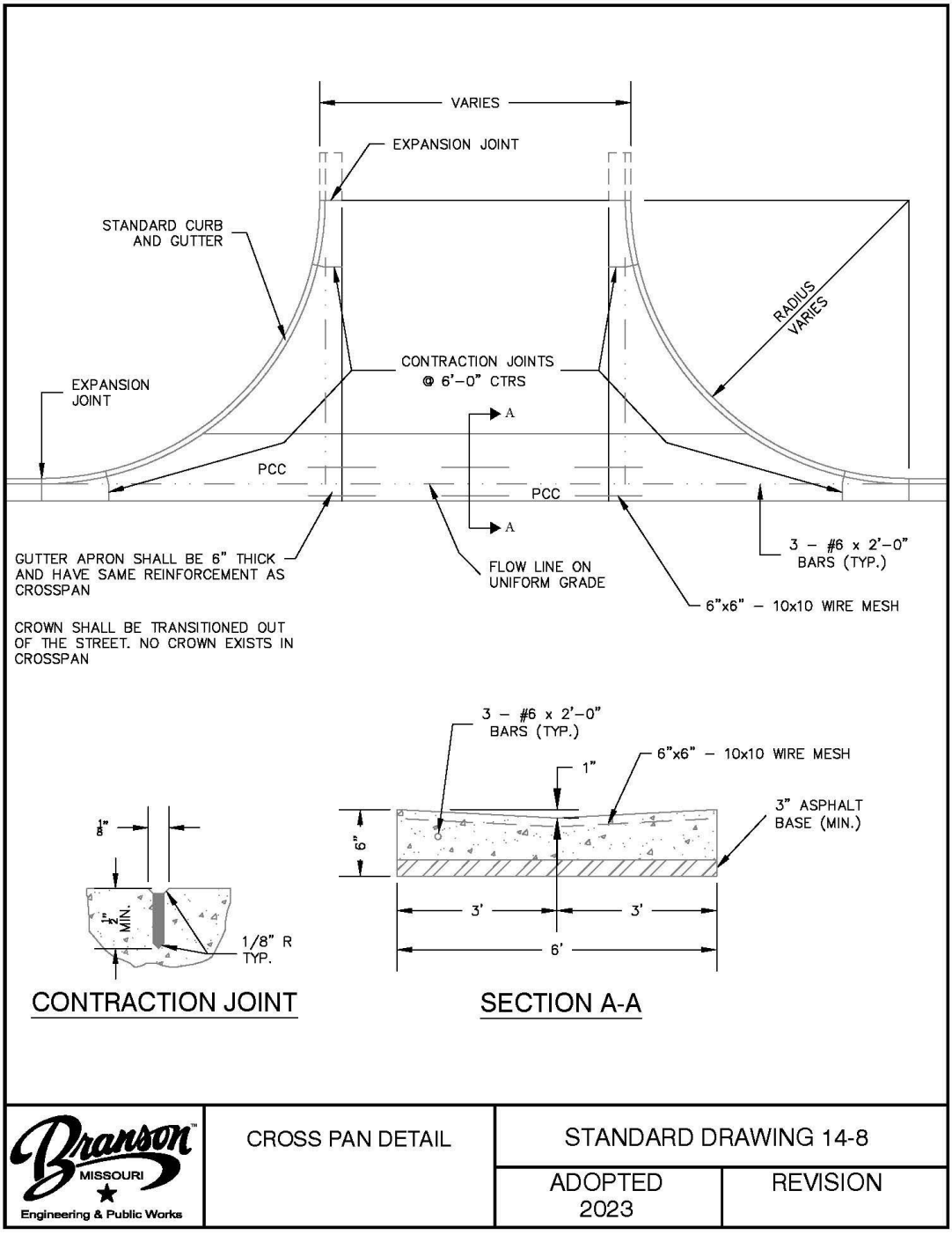

3:1 MAX
3:1 MAX
P/L
95% COMPACTION
BEHIND CURB
SUBGRADE (COMPACTED)
(95% OF STANDARD
MAXIMUM DENSITY)
9" ASPHALT CONCRETE BASE
(TYPE 1 OR 2)
1/4" / FT.
100' MINIMUM R.O.W.
52' BOC TO BOC
2" ASPHALT CONCRETE
SURFACE (TYPE 3)
1/4" / FT.
TYPE "CG-1" CURB
6" MIN. BASE ROCK 1' BEYOND CURB
AND GUTTER (COMPACTED)
(95% OF STANDARD MAXIMUM DENSITY)
24"
6"
SLOPE 1/4" / FT. TOWARDS CURB
IN ROW
P/L
3:1 MAX
3:1 MAX
Branson
MISSOURI
Engineering & Public Works
MINOR ARTERIAL STREET
TOTAL ASPHALT
DETAIL
STANDARD DRAWING 14-3
ADOPTED
2023
REVISION


CURVE INFO
1 A= 45.67'
C= 45.59'
Δ= 11.50'
R= 227.48'
T= 22.91'
2 A= 45.67'
C= 45.59'
Δ= 11.50'
R= 227.48'
T= 22.91'
3 A= 11.65'
C= 7.23'
Δ= 175.69'
R= 3.62'
T= 96.16'
CAR STORAGE LENGTH (VARIES)
45.59'
111.02' TYP.
62.21'
PHC OR PHT
PHRC
1.37'
227.48' R
STREET C/L
227.48'R
3.62'R
SOD
2" TYPE "CG-1" CURB AND GUTTER
1/4" x 5" STEEL LANDSCAPE BORDER
CONCRETE PAVER MEDIAN
SEE TAPER DETAIL
3.25' C/L (TO BACK OF CURB)
36" MIN.
1/4" FT.
*CONCRETE PAVER MEDIAN
EXPANSION JOINT
1" SAND LAYING COURSE
4" OF 3000 PSI CONCRETE
ASPHALTIC CONCRETE BACKFILL (BM-2C)
VARIES
1/4" FT.
SOD
COMPACTED BACKFILL (95% OF STANDARD MAXIMUM DENSITY) MEDIAN MATERIAL APPROVED BY CITY
SECTION B--B
*CONCRETE PAVER TYPE, PATTERN AND COLOR TO BE SELECTED BY CITY ENGINEER
10' CONC. TAPER
4.5'
2' TYPE "CG-1" CURB AND GUTTER TAPER DETAIL
2.25' R
6" MIN.
10' CONC. TAPER
3" R
3"
SECTION C--C
NOSE DETAIL
LEFT TURN BAY ISLANDS
Branson MISSOURI
Engineering & Public Works
MINOR ARTERIAL STREET TYPICAL MEDIAN DETAIL
STANDARD DRAWING 14-4
ADOPTED 2023
REVISION

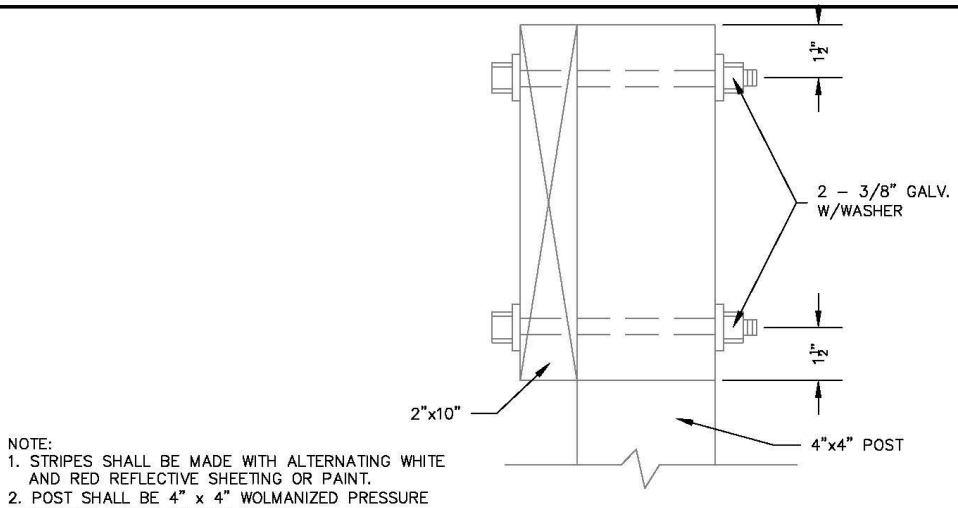

RIGHT OF WAY
RIGHT OF WAY
120.0'
8.0'
1.0'
8.0'
8.0'
2.0'
28.0'
24.0'
2.0'
14.0'
MEDIAN
2.0'
28.0'
24.0'
2.0'
8.0'
1.0'
8.0'
8.0'
3
1
SIDEWALK
SIDEWALK
TYPE "CG-1" (TYP)
FILL SECTION
1/4":1'
1/4":1'
2%
2%
C/L
6" BASE ROCK (COMPACTED) TO
95% OF STANDARD MAXIMUM
DENSITY (6" MIN.).
2" ASPHALTIC CONC. SURFACE (TYPE 3)
9" ASPHALTIC CONCRETE BASE
(TYPE 1 OR 2)
12" (TYP.)
4" ABOVE TOP OF CURB
CUT SECTION
1
4
Branson
MISSOURI
Engineering & Public Works
MAJOR ARTERIAL STREET
TOTAL ASPHALT
DETAIL
STANDARD DRAWING 14-5
ADOPTED
2023
REVISION


TYPICAL LEFT TURN LANE
10.0'
B
B
A
A
CONCRETE PAVER MEDIAN
STORAGE LENGTH L
150'R
42.0'
42.0'
150'R
1/4" x 5" STEEL LANDSCAPE BORDER
CENTERLINE
6.0'
12.0'
CURVE INFO
A= 42.14'
C= 42.00'
Δ= 16.10'
R= 150.00'
T= 21.21'
A= 42.14'
C= 42.00'
Δ= 16.10'
R= 150.00'
T= 21.21'
SECTION A - A
ASPHALTIC CONC. SURFACE
1/2" EXPANSION JOINT
6" MIN. ASPHALTIC CONCRETE BASE 6" BEYOND CURB AND GUTTER (COMPACTED) (95% OF STANDARD MAXIMUM DENSITY)
CONDUIT FOR FUTURE UTILITIES
2.0'
VARIES 3.0' MIN.
2.0'
TYPE "CG-1" C & G
CONCRETE PAVER MEDIAN PAVING MATERIAL APPROVED BY CITY
P.C. CONCRETE FOUNDATION
SECTION B - B
CAP OR PLUG CONDUIT
3"
10.0' CONC. TAPER
1/2" EXPANSION JOINT
6" MIN.
CONCRETE PAVER MEDIAN
Branson MISSOURI
Engineering & Public Works
MAJOR ARTERIAL STREET TYPICAL MEDIAN DETAIL
STANDARD DRAWING 14-6
ADOPTED 2023
REVISION


NOTE:
CAP FURNISHED BY CONTRACTOR MARKER TO HAVE SECTION, TOWNSHIP, AND RANGE STAMPED ON THE TOP WITH TRUE SECTION CORNER ETCHED ON THE SURFACE BY SURVEYOR LICENSED IN THE STATE OF MISSOURI.
FINISH GRADE
NEENAH R-1968 TYPE 36-3 OR APPROVED EQUAL
30" STANDARD ALUMINUM PIPE MONUMENT WITH MAGNETIC CAP BERNSTEN TYPE AU-1 OR APPROVED EQUAL. SET MONUMENT SO THAT THE CAP CAN BE READ FROM THE SOUTH.
2 1/8" I.D.
CAST-IN-PLACE CONCRETE
COMPACTED MOIST SOIL BACKFILL
CAST-IN-PLACE CONCRETE
STANDARD ALUMINUM DOME TOP DISK 3 1/4" DIAMETER WITH MAGNET ATTACHED TO UNDERSIDE BERNSTEN OR EQUAL.
5"
7¼"
12¼"
26"
4"
6"
12"
STANDARD LAND CORNER MONUMENT
Branson MISSOURI
Engineering & Public Works
MONUMENT BOX DETAIL
STANDARD DRAWING 14-7
ADOPTED 2023
REVISION

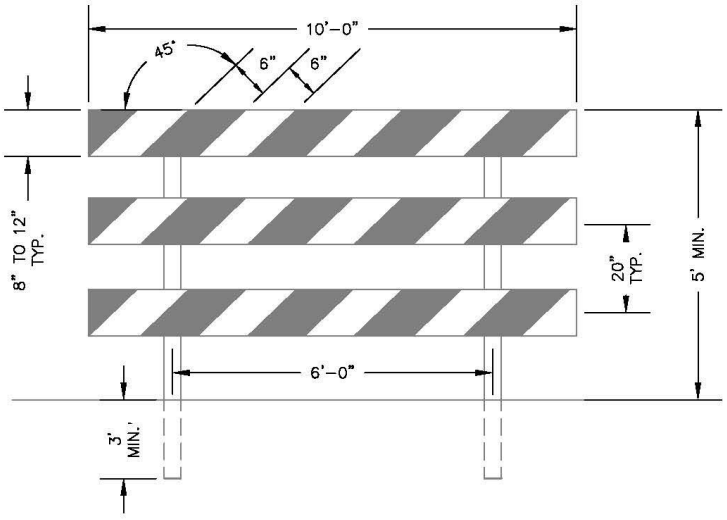



| | | | |
|---|---|---|---|
| Branson MISSOURI Engineering & Public Works | CROSS PAN DETAIL | STANDARD DRAWING 14-8 | |
| | | ADOPTED 2023 | REVISION |




NOTE:
1. STRIPES SHALL BE MADE WITH ALTERNATING WHITE AND RED REFLECTIVE SHEETING OR PAINT.
2. POST SHALL BE 4" x 4" WOLMANIZED PRESSURE TREATED CEDAR PAINTED WHITE.

## MOUNTING DETAIL




## TYPE III BARRICADE

| | | | |
|---|---|---|---|
| Branson MISSOURI ★ Engineering & Public Works | END OF PAVEMENT TYPE III BARRICADE | STANDARD DRAWING 14-9 | |
| | | ADOPTED 2023 | REVISION |

# SECTION 1450 PAVEMENT STRIPING AND MARKING

1451 SCOPE. Permanent pavement striping and marking shall be applied to the final pavement surface as described on the Striping and Signing Plan included in the contract drawings. This section governs the furnishing of labor, equipment, and materials and for the performance of work necessary to furnish and install white and yellow permanent or temporary retro–reflectorized pavement marking materials as shown on the Plans and in accordance with the Standard Drawings, the specifications and the Special Provisions.

## 1452 MATERIALS.

A. Painted Striping. If painted striping is to be applied under the provisions of the contract, the paint and glass beads shall be of good commercial quality and shall be approved for use by the Engineer

B. Thermoplastic Pavement Marking. If thermoplastic marking material is to be applied under the provisions of the contract, the materials shall conform to Section 620 of the Missouri Highway and Transportation Department Standard Specifications. Thermoplastic pavement marking shall be used for all longitudinal and diagonal lines and striping and transverse markings such as arrows, stop bars and word messages.

## 1453 PREFORMED PAVEMENT MARKING TAPE.

A. Description. This work shall consist of furnishing and placing preformed marking tape of the type and at the location as shown on the plans or as directed by the Engineer.

The contractor has the option to use thermoplastic pavement material in lieu of Type 1 or Type 2 preformed marking tape at the price bid for Type 1 or Type 2 marking tape.

## 1454 CONSTRUCTION REQUIREMENTS.

A. Type 1 or Type 2 preformed marking tape shall be installed as shown on the plans, or as directed by the Engineer. The placement width of asphaltic concrete shall be adjusted such that the tape will not fall on a longitudinal joint.

B. Lines shall be either white or yellow, continuous or intermittent and of the widths and configurations required.

C. Arrows, words, and symbols shall be white and may be formed from one piece, multiple pieces, or strips of the tape material.

D. Type 1 tape shall be embedded or inlaid in the asphalt surface by the final roller. Type 2 tape shall be placed on the asphalt surface after final rolling operations are complete.

E. Any intermediate or previously existing markings, except edge lines, which are obliterated by the final wearing surface shall be replaced with the type of marking material as shown on

the plans, no later than the end of the same day. The contractor shall begin centerline and lane line striping at the beginning of the last existing 10-foot stripe in order to maintain a 40-foot cycle along the entire pavement.

## 1455 METHOD OF MEASUREMENT.

A. Measurement of lines will be made to the nearest 10 linear feet of marking tape used.

B. Measurement of arrows, words, and symbols will be made per each.

C. Accepted preformed pavement marking tape will be paid for at the unit price for each of the pay items included in the contract.

## 1456 THERMOPLASTIC PAVEMENT MARKING.

A. Description. This work shall consist of furnishing materials and placing thermoplastic pavement marking at locations and of the dimensions shown on the plans or as directed by the Engineer.

## 1457 CONSTRUCTION REQUIREMENTS.

A. Equipment. All equipment for application of thermoplastic marking material shall be of such design and maintained in such condition as to properly heat, mix, and apply the materials.

1. Melting Kettle. The melting kettle shall be capable of heating the thermoplastic material to its recommended application temperature without scorching and shall be capable of maintaining that temperature. The heating kettle shall have a heat transfer medium and the flame shall not come in direct contact with the material container surface. A temperature gauge shall be visible on the outside of the kettle to indicate the temperature of the thermoplastic material. The melting kettle shall have a continuous mixer or agitator capable of thoroughly mixing the material at such a rate as to maintain homogeneity of material and uniformity of temperature throughout.

2. Thermoplastic Dispensing Devices. The equipment may be mobile or portable and shall be capable of applying molten thermoplastic material at the temperature recommended by the manufacturer of the thermoplastic material in lines from four inches (4”) to 12 inches wide at a 125 mils thickness. Dispensing devices shall be of the extrusion type.

   a. Extrusion dispensing devices shall be capable of depositing a mass of molten thermoplastic material on the pavement where it is immediately shaped to the specified width and thickness. The extrusion device shall have a visible temperature gauge to allow monitoring of the temperature of the thermoplastic material near the point of deposition.

3. Glass Bead Dispenser. All thermoplastic dispensers shall be equipped with a drop-on type glass bead dispenser. The glass bead dispenser shall be located so as to drop the glass beads immediately after the molten thermoplastic material is applied. The glass bead dispenser shall be adjustable to regulate flow of the beads and shall uniformly dispense the glass beads.

B. Surface Preparation. The pavement surface on which the thermoplastic material is to be placed shall be clean and dry. Even if the pavement is visibly dry, subsurface moisture may be present in amounts sufficient to affect bonding. If excess pavement moisture exists, it will usually result in blisters appearing as bubbles in the hot thermoplastic material. If blisters appear, marking operations shall cease until the pavement dries.

1. Pavement surfaces shall be inspected for cleanliness and any dirt, debris, or other contaminants on the surface to be marked shall be removed. Existing painted pavement markings that would prevent a mechanical bond between the thermoplastic and the pavement shall be removed by methods approved by the Engineer. Any curing compound on new concrete pavements shall be removed by means acceptable to the Engineer.

C. Temperature Limitations. The pavement surface where the thermoplastic material is to be placed shall have a minimum temperature of 60 degrees Fahrenheit. The air temperature shall be at least 50 degrees Fahrenheit during marking operations. The pavement surface temperature and air temperature shall be determined before the start of each day of marking operation and at any other time deemed necessary by the Engineer. Temperatures are to be obtained in accordance with MHTD Test Method T20.

D. Primer Application. A primer shall be applied to bituminous surfaces over two (2) months old and all concrete surfaces. Primer is not required on new bituminous surfaces unless recommended by the manufacturer of the thermoplastic material. A new bituminous surface is one less than two (2) months old. Primer shall be applied and cured in accordance with the recommendations of the manufacturer of the thermoplastic material.

E. Thermoplastic Application. The thermoplastic marking material shall be extruded onto the pavement surface.

1. Thermoplastic marking material for use on new bituminous surfaces shall be alkyd thermoplastic. Material for use on surfaces other than new bituminous surfaces may be alkyd, hydrocarbon or epoxy type thermoplastic.

2. The temperature of the thermoplastic at the time of application shall be 400-425 degrees Fahrenheit for alkyd or hydrocarbon materials, and 450-500 degrees Fahrenheit for epoxy materials. The temperature of the thermoplastic material shall be checked at the point of deposition with a calibrated thermometer at the beginning of each day's marking, after material is added to the dispensing device, after delays in the marking operation, and any time deemed necessary by the Engineer.

3. Alkyd thermoplastic material shall not be heated above 435 degrees Fahrenheit. Hydrocarbon thermoplastic material shall not be heated above 450 degrees Fahrenheit. Only the quantity of thermoplastic that can be used within four (4) hours should be heated. In no case shall any thermoplastic material be heated for more than four (4) hours at the maximum application temperature, including initial heating. No material shall be reheated more than two times. Material subjected to these conditions will be rejected.

4. Pavement striping shall comply with the standard striping practices as shown on the plans. The contractor shall begin centerline and lane line striping at the beginning of the last existing 10-foot stripe in order to maintain a 40-foot cycle along the entire pavement.

5. Alkyd type thermoplastic lane line marking or centerline marking of the surface of newly resurfaced bituminous surfaces shall be in place at the end of each day's resurfacing if pavement is open to traffic. If the roadway shoulders are to be resurfaced, application of edge lines may be delayed for a maximum of three days or until the shoulders are resurfaced whichever comes first.

6. Furnished markings shall have well defined edges and be free of waviness. The minimum thickness of thermoplastic markings shall be 125 mils and the maximum shall be 188 mils. The thickness will be measured as a wet film except the Engineer may measure cured film by placing a tape or other bond breaker prior to placing the thermoplastic material and then removing a section of cured line and measuring thickness.

7. Damage to pavement marking caused by the contractor's operation, including resurfacing of shoulders, shall be repaired or replaced at his expense.

F. Glass Bead Application. The drop-on glass bead shall be mechanically deposited on the molten thermoplastic line immediately after placement of the thermoplastic at the rate of at least 8 pounds per 100 square feet of line. The glass beads shall not be dropped at the point of deposition of the thermoplastic or ahead of that point. The beads shall adhere to the cured thermoplastic or all marking operations shall cease until corrections are made.

G. Workmanship. The applied markings should be inspected continually for overall workmanship. Markings shall have clean cut edges and the color shall be distinctive. The glass beads shall appear uniform on the entire marking surface. Adhesion to the pavement surface shall be checked with a stiff putty knife or similar instrument. The marking should not be removable from a concrete surface. The marking can be removed from a bituminous surface, however, residue of the bituminous substrate shall be stuck to the marking material.

1. If the thermoplastic line does not provide initial nighttime reflectivity or if the marking does not have the required minimum thickness, the contractor shall at his expense grind away the surface of the deficient portion of the marking to reduce the average thickness to 50 mils or less. The contractor shall then at his expense

apply additional thermoplastic material to a total thickness of at least 125 mils and provide a uniformly reflective surface. If the markings do not comply with the specifications for any other reason, the engineer may require complete removal or correction at the contractor's expense.

H. Method of Measurement.

1. Measurement of thermoplastic pavement marking will be made to the nearest 10 linear feet from point of beginning to point of ending for each line. Where intermittent lines are specified, deduction will be made for the gaps in the striping.

2. Measurement of arrows, words, symbols or markings other than lines will be made per each.

3. Final measurement will not be made except for authorized changes during construction or where appreciable errors are found in the contract quantity.

a Basis of Payment. The accepted quantity of thermoplastic pavement marking will be paid for at the contract unit price.

## 1458 REMOVABLE PAVEMENT MARKING

A. Description. This work shall consist of pavement striping, either by painting or by application of preformed removable tape, to delineate traffic lanes on bypasses, temporary connections, existing pavements, and new pavements used for handling traffic during construction. On new pavements and existing pavements that are to remain in place, preformed removable tape shall be used. This work shall also include all necessary operations for removal of existing pavement markings which might mislead traffic, and the removal of painted lines and preformed removable tape when no longer required.

1. If in the judgment of the engineer, the weather or pavement condition is unsuitable for the proper adhesion of removable tape, the contractor may use painted lane lines providing proper adhesion is attained. If painted lines are used or permitted, the paint and beads shall be of good commercial quality and shall be approved for use by the engineer.

B. Construction Requirements.

1. Removable pavement marking for edge lines, centerlines, stop lines, and lane lines shall be as shown on the plans or as directed by the engineer.

2. All removable pavement marking within the project limits shall be maintained by the contractor at his expense in a manner approved by the engineer.

3. Removal of all pavement markings within project limits will be shown on the plans. Preformed removable tape shall be removed by hand methods. Paint shall be removed from portland cement concrete pavement by a high pressure water blast

method, or a low pressure water and sand blast method, or a steel shot blast method. Paint shall be removed from bituminous pavement by either a low pressure water and sand blast method or by a steel shot blast method. Paint shall be removed without damaging the surface or texture and without leaving an image which might mislead traffic. High pressure water blast methods shall not exceed 10,000 pounds per square inch. Low pressure water and sand blast method shall not exceed 3,000 pounds per square inch.

C. Method of Measurement

1. Measurement of removable pavement marking and the removal of pavement markings will be made to the nearest 10 feet as measured along the center line of the pavement from point of beginning to point of ending for each line and totaled to the nearest 100 feet. Where intermittent lines are specified or existing, deduction will be made for gaps in the striping and removal. Measurement will not be made for removal of stripes within the limits of a bypass roadway or other roadway to be obliterated at the completion of the project.

2. Final measurement will not be made except for authorized changes during construction or where appreciable errors are found in the contract quantity. The revision or correction will be computed and added to or deducted from the contract quantity.

D. Basis of Payment. The accepted quantity of removable pavement marking and the removal of pavement markings will be paid for at the unit price for each of the pay items included in the contract. When painted lines are used in lieu of preformed removable tape, due to weather or pavement conditions, payment will be made at 50 percent of the unit price for the pay items affected.

## 1459 SHORT TERM PAVEMENT MARKING

A. Description. This work shall consist of furnishing, installing, and maintaining preformed short term pavement marking tape on bituminous resurfacing projects.

B. Materials. At the option of the contractor, machine applied traffic paint and glass beads may be used in lieu of preformed short term marking tape provided satisfactory reflectivity is obtained.

C. Construction Requirements.

1. When the contractor's work has obliterated the existing traffic striping on resurfacing projects open to through traffic, the contractor shall provide and maintain short term pavement marking. The center line and lane lines of all lanes subject to traffic during construction shall be marked. The short term pavement marking shall be in place at the end of each day's work between all lanes open to traffic.

2. The center line marking shall be yellow for a two-lane road with opposing traffic and the lane lines shall be white for a two-lane road with one-way traffic. Preformed marking tape shall be applied in increments four feet (4') long parallel to the direction of traffic flow at approximately 40-foot intervals.

3. The center line marking of pavement of sufficient width to accommodate four or more undivided lanes carrying opposing traffic shall be marked with two parallel lines of yellow preformed marking tape separated by a four inch (4") space. Lane lines for these pavements shall be marked with white preformed marking tape in increments 4 feet long at approximately 40-foot intervals.

D Method of Measurement.

1. Measurement of short term pavement marking will made to the nearest 1/10 mile as measured along the center line of the pavement, or each pavement of a divided highway, regardless of the number of applications.

2. Final measurement will not be made except for authorized changes during construction or where applicable errors are found in the contract quantity. The revision or correction will be computed and added to or deducted from the contract quantity.

3. Basis of Payment. The accepted quantity of short term pavement marking will be paid for at the contract unit price.

SECTION 1500 PORTLAND CEMENT CONCRETE PAVEMENT

1501 SCOPE. This section governs the furnishing of all labor, materials and equipment for the placement of Portland Cement Concrete Pavement as shown on the Plans and in accordance with the Standard Drawings, the specifications, and the Special Provisions.

1502 MATERIALS. Except as modified herein, all materials used for construction of Portland Cement Concrete pavement shall conform to the requirements stipulated in applicable sections of these Specifications.

A. Concrete: The concrete for the use in construction of Portland Cement Concrete pavement shall conform to the requirements established in Section 2000, "Concrete" with the following modifications.

| | |
|---|---|
| Cement | Portland Cement shall conform to ASTM C150, Type II. Type III cement may be used only upon written approval of the City Engineer. |

B. Reinforcement:

Bars: Non-epoxy coated bars shall conform to ASTM A 615. Epoxy coated bars shall conform to ASTM A 775.

Welded Steel Wire Fabric: Welded steel wire fabric shall conform to ASTM A 1064.

Supporting Elements: Representative samples of supporting elements shall be submitted and approved by the Engineer prior to their use in the project.

Fibers: When specified in the Contract Documents, fibers shall be incorporated into the concrete at the rate recommended by the manufacturer but no less than a minimum of 3 pounds per cubic yard of concrete for macro fibers and 1 pound per cubic yard of concrete for micro fibers. Fibers shall meet the requirements of MODOT Standard Specifications for Highway Construction, 2023 Edition, 505.60.2.3.

C. Isolation Joint Fillers: Isolation joint fillers shall conform to ASTM D 1751, D 1752, or ASTM D 7174.

D. Joint Sealing Compounds: Joint sealing compounds shall conform to the standards for the type of sealant specified as listed in the following table:

| Joint Seals and Sealants | AASHTO | ASTM |
|---|---|---|
| Hot-poured, Polymeric Asphalt Based | M 324 | D 6690 |
| Preformed Polychloroprene Elastomeric | | D 2628 |
| Lubricant for Installation of Preformed Seal | ----- | D 2835 |
| Preformed Expansion Joint Filler | M 213 | D 1751, D 1752 or D 7174 |

E. Curing Membrane: All material to be used or employed in curing Portland Cement Concrete must be approved by the Engineer prior to its use. It shall be of the liquid membrane type and shall conform to ASTM C 309, Type II, Class B or AASHTO M 148, Type 2, white pigmented.

1503 CONSTRUCTION DETAILS. The Portland Cement Concrete pavement shall be constructed to the configuration, and to the lines and grades shown on the plans.

A. Grading and Subgrade Preparation: Grading, Subgrade Preparation and Base Course: All excavation, embankment, subgrade stabilization or aggregate base course required shall be as defined in Sections 1000 “Site Preparation”, 1100 “Grading”, 1200 "Subgrade Preparation", and 1250 “Aggregate Base Course”. If areas of the subgrade are below the lines, grades and cross-sections shown on the Plans, they shall be brought to the proper line, grade and cross-section by one of the following:

1. Additional fill material placed in accordance with applicable sections.

2. Areas may be filled with additional thickness of Portland Cement Concrete Pavement.

B. Surface Preparation for Concrete Overlay: Prepare surface for concrete overlay as specified in the National Concrete Pavement Technology Center Guide Specifications for Concrete Overlays, September 2015.

C. Forms: All forms shall be in good condition, clean, and free from imperfections. Each form shall not vary more than 1/4 inch in horizontal and vertical alignment for each 10 feet of length.

1. Material & Size: Forms shall be made of metal and shall have a height equal to or greater than the prescribed edge thickness of the pavement slab. Wood forms may be substituted when approved by Engineer and if they are free from warp with sufficient strength for the intended application.

2. Strength: Forms shall be of such cross-section and strength, and so secured as to resist the pressure of the concrete when struck off, vibrated, and finished, and the impact and vibration of any equipment which they may support.

3. Installation: Forms shall be set true to line and grade, supported through their length and, joined neatly in such a manner that the joints are free from movement in any direction.

4. Preparation: Forms shall be cleaned and lubricated prior to each use and shall be so designed to permit their removal without damage to the new concrete.

5. Paving Machine: A slip-form paving machine may be used in lieu of forms. The machine must be equipped with mechanical internal vibrators, and be capable of placing the Portland Cement Concrete pavement to the correct cross-section, thickness, line and grade within the allowable tolerances.

1504 JOINTS: Generally, joints shall be formed at right angles to the true alignment of the pavement and to the depths and configuration specified by the appropriate standard or as modified by the Plans and specifications. For additional guidance on jointing, see American Concrete Paving Association jointing guides. All joints shall be sealed with sealant meeting the requirements of Section 2003.E. Unless specified otherwise on the Plans, specifications, Standard Drawings or Special Provisions, use hot-poured joint sealant.

A. Isolation Joints: Isolation joints shall be placed at all locations where shown on the plans and standard details or as directed by the Engineer.

1. Isolation joints shall extend the entire width of the pavement and from the subgrade to the surface of the pavement. The material will have a suitable tear strip or removable cap provided to allow for the application of the joint sealer to the required depth.

2. Under no circumstances shall any concrete be left across the isolation joint at any point.

3. Material: Isolation joints shall be formed by a one piece, one-inch-thick preformed joint filler cut to the configuration of the correct pavement section.

4. Stability: Isolation joints shall be secured in such a manner that they will not be disturbed during the placement, consolidation and finishing of the concrete.

5. Dowels: If isolation joints are to be equipped with dowels they shall be of the size and type specified, and shall be firmly supported in place, by means of a dowel basket which shall remain in place. Each dowel shall be lightly painted or greased with a product approved by the Engineer.

B. Contraction Joints: Contraction joints shall be placed where indicated and to the depth indicated by the Plans, specifications and Standard Drawings.

1. Method: Contraction joints shall be sawed.

2. Sawing: When sawing joints, the Contractor shall begin as soon as the concrete hardens sufficiently to prevent excessive raveling along the saw cut and shall finish before conditions induce uncontrolled cracks, regardless of the time or weather. All sawed joints shall begin with a relief cut that shall be approximately 1/8-inch-wide,

and a minimum of 1/3 the thickness of the slab unless shown otherwise on the Plans. If the Plans indicate a joint width greater than 1/8" but with no backer rod, the Contractor may saw the initial relief cut to the full width. If a reservoir cut is specified that uses a backer rod, a second stage saw cut which widens the joints to allow the insertion of joint sealing material shall be performed. The second stage saw cut shall not be performed until the concrete is at least 48 hours old and shall be delayed longer when the sawing causes raveling of the concrete. If second stage sawing is performed prior to the completion of the curing period, the Contractor shall maintain the cure by use of materials approved by the Engineer.

3. The Contractor shall be responsible for using suitable methods to cut joints straight and in the correct location. The Contractor shall protect joints from damage until completion of the project and shall repair damaged joints to the satisfaction of the Engineer.

4. Where not indicated on the Plans or Standard Drawings, joint spacing for concrete overlays shall not exceed 12 times the thickness of the overlay, and shall be constructed such that the larger dimension of any panel does not exceed 125% of the smaller dimension. Joints of adjacent panels shall be aligned. Joints shall intersect pavement free edges at 90 degrees, and shall extend a minimum of 1 foot from the pavement edge. Saw joints shall be one-third the thickness of the slab, or two inches, whichever is greater.

5. For bonded concrete overlays, joints shall be located above existing joints, shall be sawed full depth plus one-half inch for overlays up to 4 inches in two stages. The first stage provides a relief cut approximately 1/8 inch wide.

6. Dowels: If contraction joints are to be equipped with dowels they shall be of the size and type specified and shall be firmly supported in place and accurately aligned parallel to the pavement line and grade with an allowable tolerance of 1/8 inch.

C. Longitudinal and Construction Joints: Longitudinal joints and construction joints shall be placed as shown on the Plans or where the Contractor's construction procedure may require them to be placed with approval of the Engineer. Longitudinal construction joints (joints between construction lanes) shall be keyed or tied joints of the dimensions shown on the Plans or Standard Drawings. Transverse construction joints of the type shown on the Plans or Standard Drawings shall be placed wherever concrete placement is suspended for more than 30 minutes. Unless shown otherwise on the Plans, do not place a construction joint within 5 feet of another transverse expansion, contraction or construction joint.

D. Center Joints: Longitudinal center joints shall be constructed using the methods specified in Section 1504(B) "Contraction Joints".

E. Tie bars: Tie bars shall be of deformed steel of the dimensions specified by the plans or

standard drawings. Tie bars shall be installed at the specified spacing and firmly secured so as not to be disturbed by the construction procedure

1505 PLACING, FINISHING, CURING, AND PROTECTION: Concrete shall be furnished in quantities required for immediate use and shall be placed in accordance with the requirements of the applicable specification as stipulated in Section 2003.B. Prior to commencing construction, the Contractor shall furnish a concrete delivery plan which includes at a minimum the number of trucks which will be dedicated to the project, the location of the concrete plant, the route and distance from the plant to the job site, and the anticipated rate of concrete usage. It is essential that concrete be delivered in sufficient quantities to prevent stoppage of the paving operation.

A. Concrete Placement: The concrete shall be deposited on the subgrade to the required depth and width of the construction lane in successive batches and in a continuous operation without the use of intermediate forms or bulkheads. The subgrade shall be moistened prior to the placement of concrete. The concrete shall be placed as uniformly as possible in order to minimize the amount of additional spreading necessary. The concrete shall not be permitted to drop freely a distance of greater than 3 feet. While being placed, the concrete shall be vibrated and compacted with suitable tools so that the formation of voids or honeycomb pockets is prevented.

The concrete shall be well vibrated and tamped against the forms and along all joints. Care shall be taken in the distribution of the concrete to deposit a sufficient volume along the outside form lines so that the curb section can be consolidated and finished simultaneously with the slab.

No concrete shall be placed around manholes or other structures until they have been brought to the required grade, alignment, and cross slope.

Concrete shall not be allowed to extrude below the forms.

Limitations for time of placement and other items not specifically covered by this specification shall be in accordance with the most recent Standard Specifications of the State Department of Transportation for the state the work is being performed in. The Engineer may extend placement time limitations based on field conditions and concrete consistency and workability.

B. Concrete Finishing.

1. Do not apply moisture (water, finishing aids, etc.) to the surface of the concrete pavement. The concrete should be provided with proper consistency and workability to place, strike off, consolidate, finish and texture without the addition of moisture. Only in the event of exceptional and unusual circumstances may the Engineer consider allowing a fine, fog mist to be added.

2. Floating: All surfaces shall be consolidated and floated after strike-off and prior to final surface finish.

3. Straightedging: Following the floating and while the concrete is still plastic, the surface shall be tested for trueness with a 10-foot straightedge placed parallel to the centerline and operated across the entire width of the pavement. The straightedge shall be advanced in successive stages not to exceed half its length and the operation repeated. Surface deviations greater than 1/8 inch shall be corrected and the straightedging repeated. Straightedging may be eliminated if the pavement smoothness is verified using a profilograph.

4. Edging: Before final finishing is completed and before the concrete has taken its initial set, the edges of the slab and curb shall be finished to 1/8" radius, or that shown on the Plans or Standard Drawings by the paving equipment, or with hand edging tools.

5. Final Surface Finish:

   a. Dragged Surface Treatment: For roadways with a design speed of 45 mph or less to be posted at 45 mph or less, Astroturf or burlap shall be dragged longitudinally over the finished surface to produce a tight, uniform, textured surface, and the edges shall be rounded in a workmanlike manner.

      For roadways to be posted at 50 mph or more, Astroturf or burlap shall be dragged longitudinally over the finished surface to produce a tight, uniform, textured surface, and the edges shall be rounded in a workmanlike manner. The texture achieved by the Astroturf or burlap drag shall be tested by the Contractor in accordance with ASTM E 965, "Test Method for Measuring Surface Macro Texture Depth Using a Sand Volumetric Technique", to ensure the texture is adequate for skid resistance. Test locations will be determined by the Engineer. The results of ASTM E 965 shall show an average texture depth of any lot, as defined below, and shall have a minimum value of 0.032 inch. Any lot showing an average of less than 0.032 inch but equal to or greater than 0.024 inch will be accepted as substantial compliance but the Contractor shall amend their operation to achieve the required 0.032-inch minimum depth. (It is not the intention of this tolerance to allow the Contractor to continuously pave with an average texture depth of less than 0.032 inch). Any lot showing an average texture depth of less than 0.024 inch shall require diamond grinding of the pavement represented by this lot to attain the necessary texture. Any individual test showing a texture depth of less than 0.020 inch shall require diamond grinding of the pavement represented by this lot to attain the necessary texture. Limits of any failing individual test shall be determined by running additional tests at 100 foot intervals before and after the failing test location. All testing of the surface texture shall be completed no later than the day following pavement placement.

C. Groove Treatment: For roadways to be posted at 50 mph or more, the surface of the traveled lanes shall be grooved in a transverse direction unless specified otherwise in the Plans, Special Provisions, or Specifications. If approved by the Engineer, a suitable longitudinal grooving or a dragged surface treatment as described in Section 1505.B.5 may be used in lieu of the transverse grooving. Surface grooving shall be done with a mechanical device such as a wire broom or comb or by hand. The broom or comb shall have a single row of spring steel tines, rectangular in cross section, 1/8 inch to 3/16-inch-wide; spaced on 3/4 inch centers of sufficient length, thickness, and resilience to form grooves to a depth of a minimum of 1/8 inch and a maximum of approximately 3/16 inch in the plastic concrete. If grooves are to be installed by hand, the proposed equipment and process to be used shall be approved by the Engineer. This operation shall be done at such time and in such manner that the desired surface texture will be achieved while minimizing displacement of the larger aggregate particles and before the surface permanently sets. Where abutting pavement is to be placed, the grooving should extend as close to the edge as possible without damaging the edge. If abutting pavement is not to be placed, the 6-inch area nearest the edge or 1 foot from the face of the curb is not required to be grooved. For small or irregular areas or during equipment breakdown, grooving may be done by hand methods. Curing: As soon as practical after the concrete is finished it shall be cured with an approved curing method. If a liquid curing membrane is used, it shall be white pigmented and applied in accordance to the manufacturer's directions.

1. Method of Applying Curing Membrane: A nozzle producing a uniform fan pattern will be used on all spray equipment when applying the liquid curing membrane. The curing compound should be applied immediately after final finishing, and before the loss of all free water on the surface of the concrete. Normally one smooth, even coat shall be applied at a rate of 150 to 200 square feet per gallon, but two coats may be necessary to ensure complete coverage and effective protection. Second coats should be applied at right angles to the first.

2. Curing Formed Surfaces: If the forms are removed from finished concrete pavement within a period of 72 hours or if a slip-form paving machine has been used, all exposed surfaces shall be cured. Curing membrane damaged by joint sawing operations shall be repaired by the Contractor as directed by the Engineer.

D. Protection: The Contractor shall, at his own expense, protect the concrete work against damage or defacement of any kind until it has been accepted by the Engineer. All vehicular traffic shall be prohibited from using the new concrete pavement until the following criteria have been met:

1. Construction traffic: New concrete pavement may be opened to light construction traffic after a minimum of four (4) days of cure time has elapsed and the joints have been protected from the intrusion of foreign material by an approved method. The Contractor may reduce this length of time by one of these options, performed at the expense of the Contractor:

   a. Achieve a minimum compressive strength of 70% of the 28-day design strength as determined in accordance with ASTM C 39.

b. Achieve a minimum flexural strength of 350 psi using a third point loading method.

2. All traffic: New concrete pavement may be opened to all traffic after a minimum of seven (7) days of cure time has elapsed and the joints have been sealed in accordance with Section 2208.4.D. The Contractor may reduce this length of time by one of these options, performed at the expense of the Contractor:

a. Achieve a minimum compressive strength of 100% of the 28-day design strength as determined in accordance with ASTM C 39.

b. Achieve a minimum flexural strength of 450 psi using a third point loading method.

Concrete pavement that is not acceptable to the Engineer because of damage or defacement shall be removed and replaced, or repaired, to the satisfaction of the Engineer, at the expense of the Contractor.

E. Pavement Smoothness: If required by the Contract Documents, pavement smoothness shall adhere to Section 2211. If not required by the Contract Documents, the Engineer shall determine areas to be checked for surface tolerance by the Contractor. The areas identified by the Engineer shall be checked with a 10-foot straightedge placed parallel to the center line at any location within a driving lane. Areas showing high spots of more than 1/4 of an inch in 10 feet shall be marked and ground down with approved grinding equipment to an elevation where the area or spot will not show surface deviations in excess of 1/8 inch when tested with a 10-foot straight edge. Grinding will be performed on the full width of the lane failing to meet the above criteria. The cost of correcting the smoothness and any other associated costs such as traffic control shall be at Contractor's expense.

F. Diamond Grinding: If required by the Contract Documents or if pavement smoothness criteria from Section 1503 or Section 1505.E are not achieved, the Contractor shall grind the riding surface to reduce or eliminate the irregularities.

1. Use a self-propelled grinding machine with diamond blades mounted on a multi-blade arbor. Avoid using equipment that causes excessive ravels, aggregate fractures, or spalls. Provide uniform texture the full width of the lane.

2. Transverse grooving will not be required.

3. Use vacuum equipment or other continuous methods to remove grinding slurry and residue. Prevent the grinding slurry from flowing across lanes being used by traffic or into streams, lakes, ponds or other bodies of water, inlets, storm sewer or other drainage system.

4. After corrections have been made to the riding surface, test the pavement for smoothness using the same technique used to determine smoothness originally.

Furnish and operate the smoothness measurement equipment, and evaluate the results as specified in Section 1505.E.

5. Perform additional grinding as required to attain the required smoothness. Correct all deviations (in excess of 1/2 inch in a length of 25 feet or ¼ inch in a length of 10 feet) within each section regardless of the profile index value.

G. Temperature Limitation: Concrete work shall be in accordance with the requirements of MoDOT Standard Specifications For Highway Construction.

H. Backfill: A minimum of 24 hours shall lapse before forms are removed and five (5) days shall lapse before pavement shall be backfilled unless otherwise approved by the Engineer.

Backfill shall be accomplished in accordance with these Technical Specifications.

The Contractor shall be responsible for the repair of any existing street pavement disturbed by the construction to the satisfaction of the Engineer.

I. Joint Sealing: All joints shall be sealed with an approved joint sealer meeting the requirements of Section 2003.E applied in accordance with this section and the manufacturer's directions within 7 days of the placement of the concrete and prior to the opening of the pavement to traffic. If pavement design does not specifically require the use of joint sealant, prepare the joint as described on the Plans or in the specifications.

The Contractor shall be responsible for the removal of excess dirt, rock, broken concrete, concrete splatters and overspray from the area of the construction.

1506 INTEGRAL CURB: If required by the Plans, Standard Drawings or Special Provisions, integral curbs shall be placed along the edges of all street pavement, except at such locations as the Engineer may direct.

The integral curb shall be constructed during or immediately following the finishing operation unless otherwise shown on the Plans. Special care shall be taken so that the curb construction does not lag behind the pavement construction and form a "cold joint".

Steel curb forms or integral slip-forming shall be required to form the backs of all curbs except where impractical because of small radii street returns or other special sections.

Concrete shall be consolidated with an approved vibrator.

Curbs shall be finished to the cross-section as shown on the Plans with a mule; or templates supported on the side forms and with a float not less than four feet in length, unless another method is approved by the Engineer.

The finished surface of the curb and gutter shall be checked for no more than 1/4-inch deviation by the use of a 10-foot straightedge and corrected if necessary.

Where grades are flat and while the concrete is still plastic, the flow line of the gutter should be checked by the Contractor to verify positive drainage.

Finishing, edging, curing, protection, jointing, temperature limitations and backfill shall all comply with Section 2100. The curb shall have a brush or broom finish.

1507 REPARING DEFECTS: Any defect occurring prior to final acceptance of the project or the end of a Contract warranty period shall be repaired by removing and replacing the affected area to the nearest joint, or as directed by the Engineer. After project final acceptance or expiration of the warranty period, repair defects in conformance with the following. Do not begin corrective work until after submitting a plan and receiving the Engineer's approval for repair methods.

| Defect Type | Defect Direction | Defect Location | Description | Repair Procedure | Alternate Procedure |
|---|---|---|---|---|---|
| Plastic Shrinkage Crack | Any | Anywhere | Only partially penetrates depth | Do nothing | Fill with HMWM2 |
| Uncontrolled crack | Transverse | Mid-slab | Full-depth | Saw and seal the crack | LTR3 |
| Uncontrolled crack | Transverse | Crosses or ends at transvers joint | Full-depth | Saw and seal the crack; Epoxy uncracked joint | |
| Uncontrolled crack | Transverse | Relatively parallel and within 5 ft. of joint | Full-depth | Saw and seal the crack; Seal joint | FDR4 to replace crack and joint |
| Saw cut or Uncontrolled Crack | Transverse | Anywhere | Spalled | Repair spall by PDRS if crack not removed | |
| Uncontrolled crack | Longitudinal | Relatively parallel and within 1 ft. of joint; May cross or end at longitudinal joint | Full-depth | Saw and seal the crack; Epoxy uncracked joint | Cross stitch crack |
| Uncontrolled crack | Longitudinal | Relatively parallel and in wheel path 1-4.5 ft. (from joint) | Full-depth, hairline or spalled | Remove and replace slab | Cross stitch crack |
| Uncontrolled crack | Longitudinal | Relatively parallel and further than 4.5 ft. from a long joint or edge | Full-depth | Cross-stitch crack; seal longitudinal joint | |
| Saw cut or Uncontrolled Crack | Longitudinal | Anywhere | Spalled | Repair spall by PDRS if crack not removed | |
| Uncontrolled crack | Diagonal | Anywhere | Full-depth | FDR4 | |
| Uncontrolled crack | Multiple per Slab | Anywhere | Two cracks dividing slab into 3 or more pieces | Remove and replace slab | |

HMWM = High molecular weight methacrylate poured over surface and sprinkled with sand for skid resistance.

LTR = Load-transfer restoration; 3 dowel bars per wheel path grouted into slots sawed a cross the crack; Slots must be parallel to each other and the longitudinal joint.

FDR = full-depth repair; 10 ft. long by one lane wide. Extend to nearest transverse contraction joint if 10 ft. repair would leave a segment of pavement less than 10 ft. long.

PDR = partial-depth repair; Saw around spall leaving 2 in between spall and 2 in deep perimeter saw. Chip concrete free, then clean and apply bonding agent to patch area. Place a separating medium along any abutting joint or crack. Fill area with patching mixture.

Cross-stitching: for longitudinal cracks only, drill ¾" holes at 35° angle, alternating from each side of joint on 30-36-inch spacing.

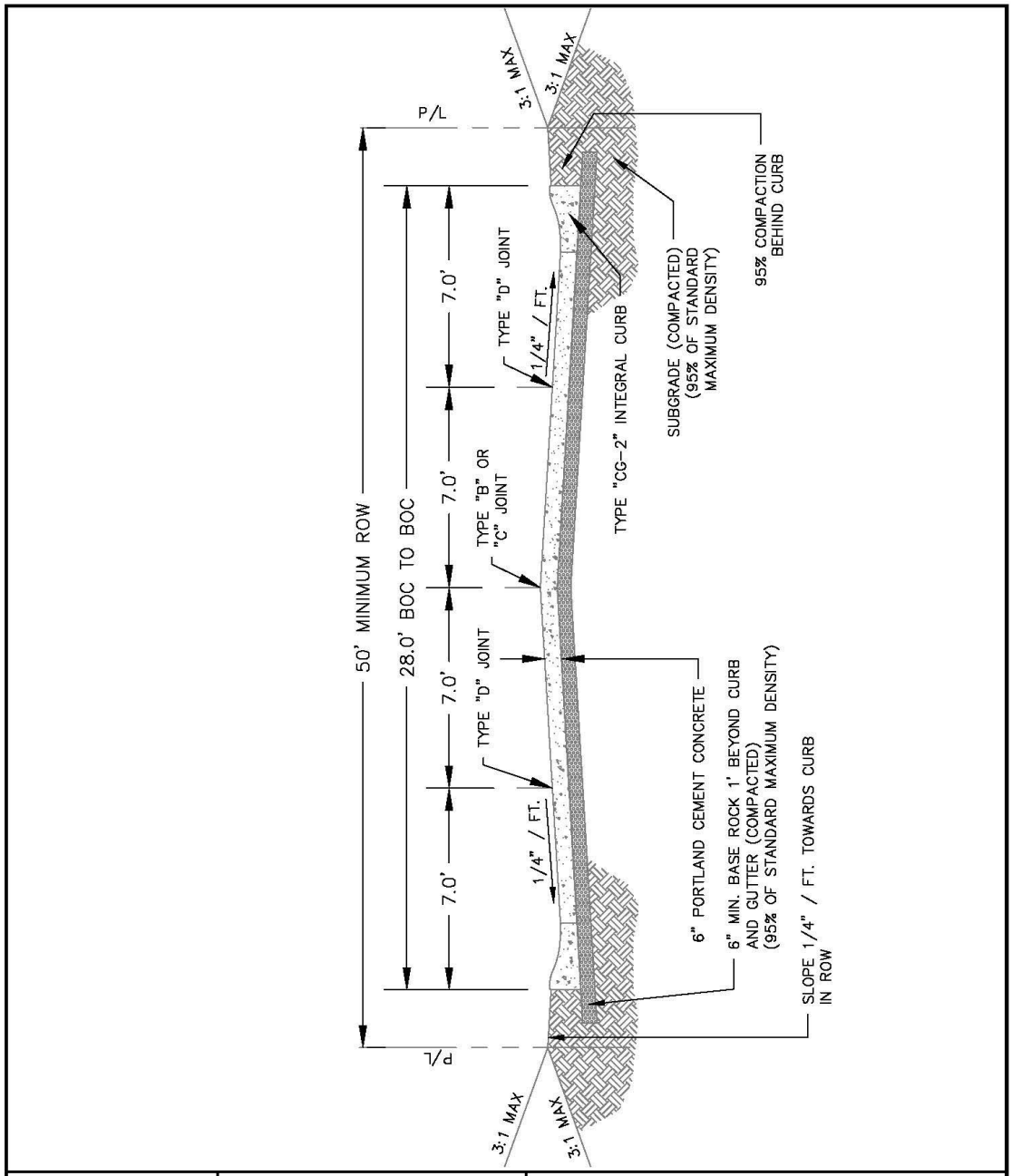
Epoxy #5 epoxy coated deformed steel tie-bars into hole.

1508 METHOD OF MEASUREMENT: Portland Cement Concrete Pavement will be measured per square yard or tenth part thereof for the specified depth.

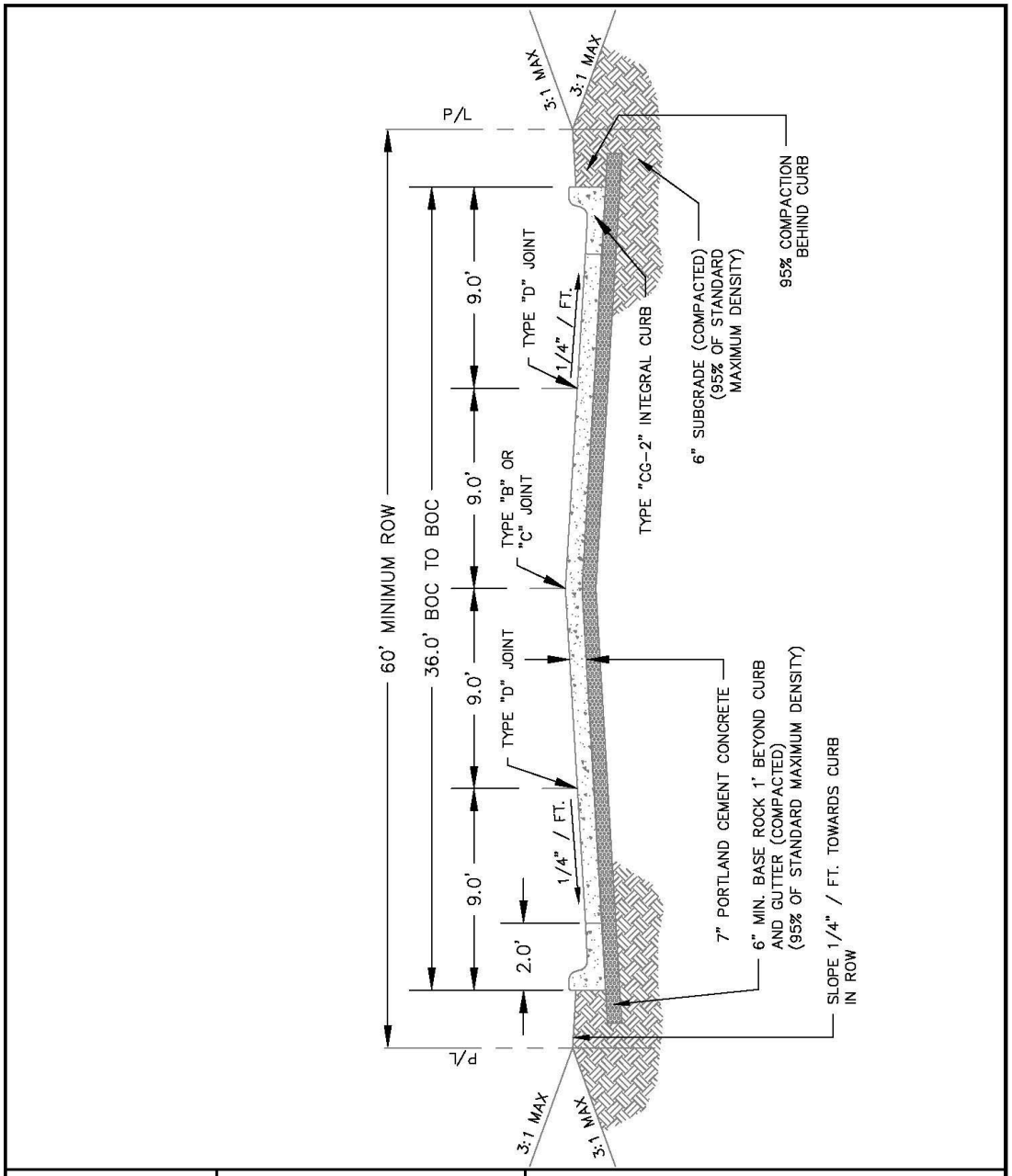
1509 BASIS OF PAYMENT:

A. Contract unit bid price.

B. Contract lump sum bid price.




| | | |
|---|---|---|
| Branson MISSOURI ★ Engineering & Public Works | LOCAL STREET DETAIL CONCRETE PAVEMENT CROSS SECTION AND AND JOINT LOCATIONS | STANDARD DRAWING 15-1 |
| | | ADOPTED 2023 / REVISION |

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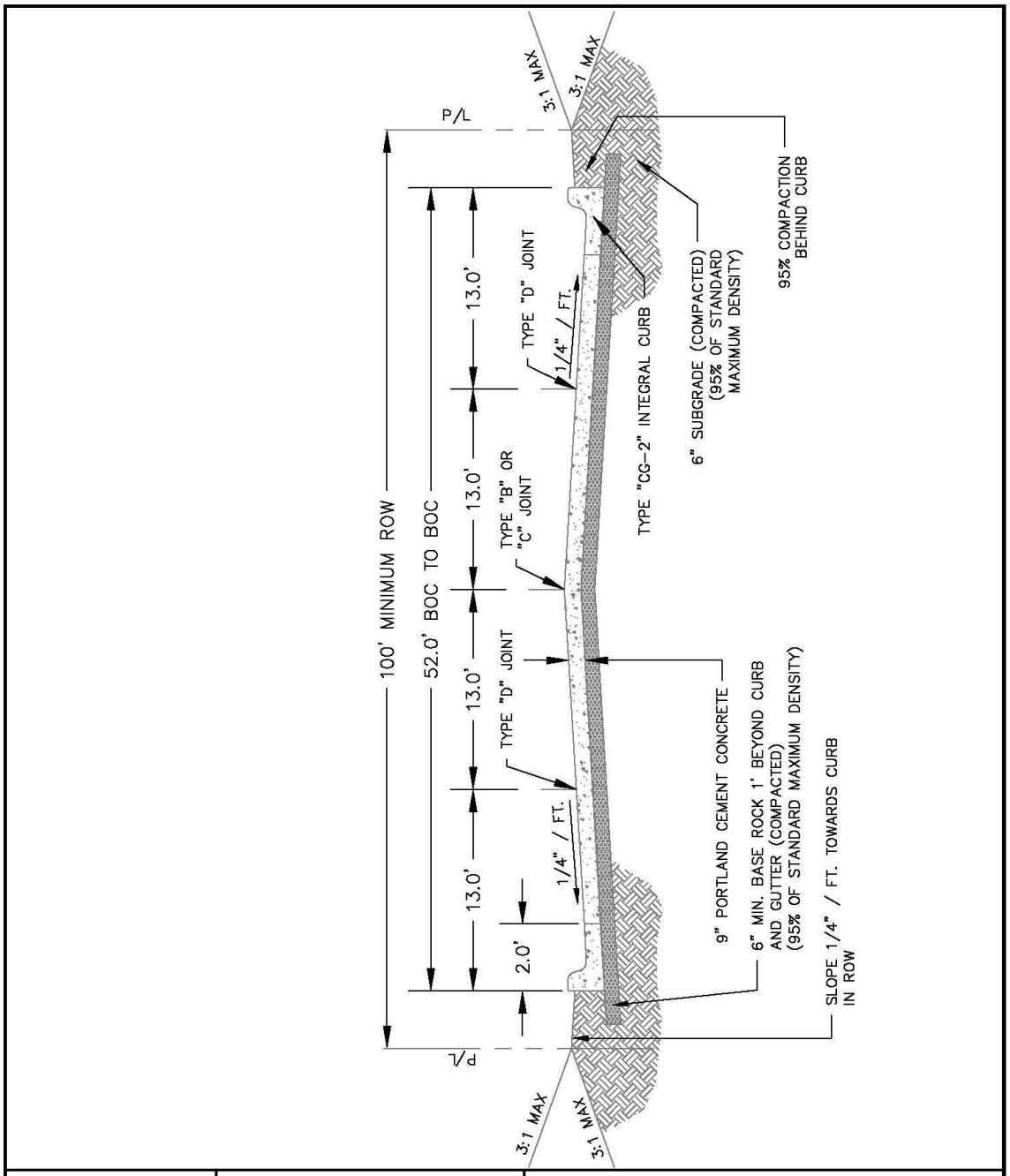
| Branson MISSOURI ★ Engineering & Public Works | COLLECTOR ST. DETAIL CONCRETE PAVEMENT CROSS SECTION AND AND JOINT LOCATIONS | STANDARD DRAWING 15-2 |
| | | ADOPTED 2023 / REVISION |

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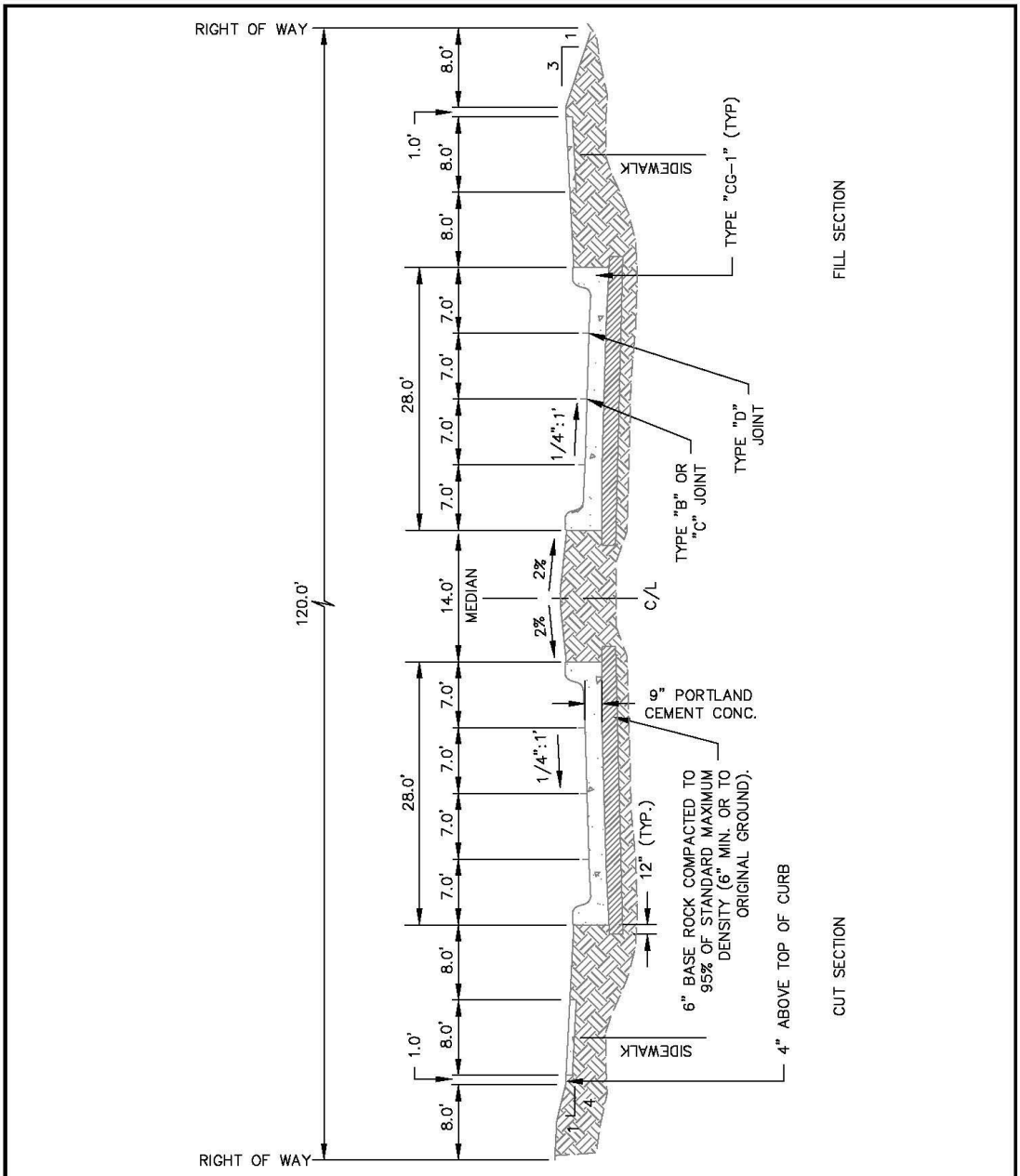
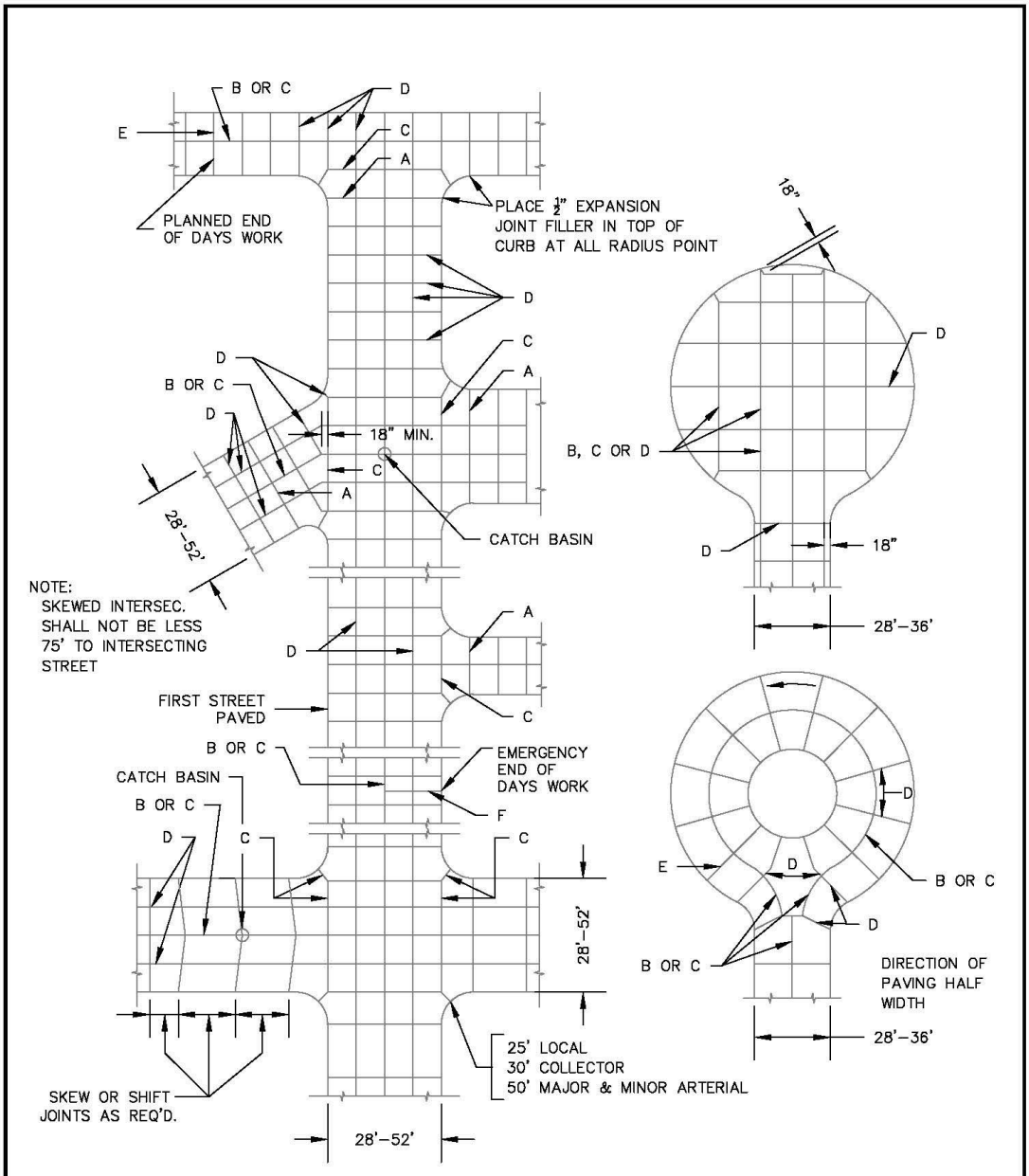
| Branson MISSOURI ★ Engineering & Public Works | MINOR ARTERIAL ST. CONCRETE PAVEMENT CROSS SECTION AND AND JOINT LOCATIONS | STANDARD DRAWING 15-3 |
| | | ADOPTED 2023 / REVISION |


RIGHT OF WAY
8.0'
1.0'
8.0'
8.0'
7.0'
7.0'
7.0'
7.0'
28.0'
120.0'
14.0'
MEDIAN
2%
2%
C/L
7.0'
7.0'
7.0'
7.0'
28.0'
8.0'
8.0'
1.0'
8.0'
RIGHT OF WAY
3
1
SIDEWALK
TYPE "CG-1" (TYP)
FILL SECTION
TYPE "D" JOINT
1/4":1'
TYPE "B" OR "C" JOINT
9" PORTLAND CEMENT CONC.
1/4":1'
12" (TYP.)
6" BASE ROCK COMPACTED TO 95% OF STANDARD MAXIMUM DENSITY (6" MIN. OR TO ORIGINAL GROUND).
4" ABOVE TOP OF CURB
SIDEWALK
CUT SECTION
1
4
Branson
MISSOURI
Engineering & Public Works
MAJOR ARTERIAL ST. CONCRETE PAVEMENT CROSS SECTION AND AND JOINT LOCATIONS
STANDARD DRAWING 15-4
ADOPTED 2023
REVISION




| | | |
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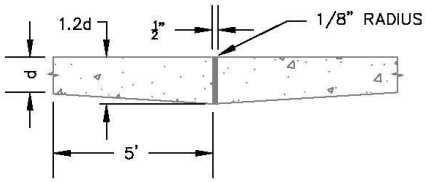
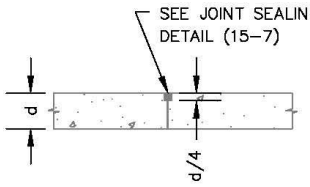
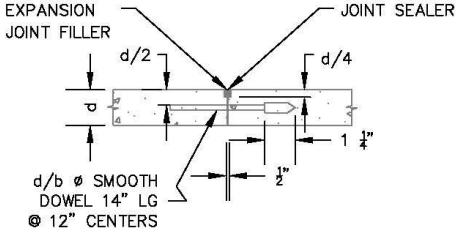
| Branson MISSOURI ★ Engineering & Public Works | CONCRETE PAVING JOINT LOCATIONS | STANDARD DRAWING 15-5 |
| | | ADOPTED 2023 / REVISION |



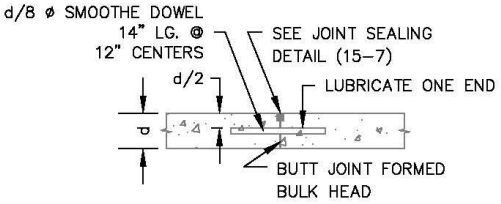

TYPE A
EXPANSION JOINT



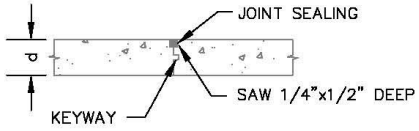

TYPE D
SAVED LONGITUDINAL OR TRAVERSE



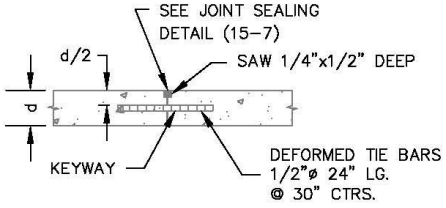

TYPE A
ALTERNATE EXPANSION JOINT



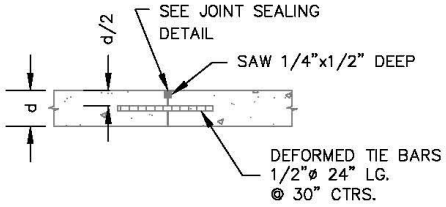

TYPE E
PLANNED TRANSVERSE CONSTRUCTION JOINT
(USED AT NORMAL JOINT SPACING)



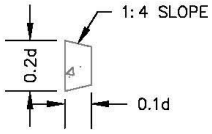

TYPE B
LONGITUDINAL CONSTRUCTION JOINT




TYPE F
EMERGENCY TIED TRANSVERSE
CONSTRUCTION JOINT
(USED AT MIDDLE THIRD NORMAL
JOINT SPACING)




TYPE C
TIED BUTT LONGITUDINAL
CONSTRUCTION JOINT

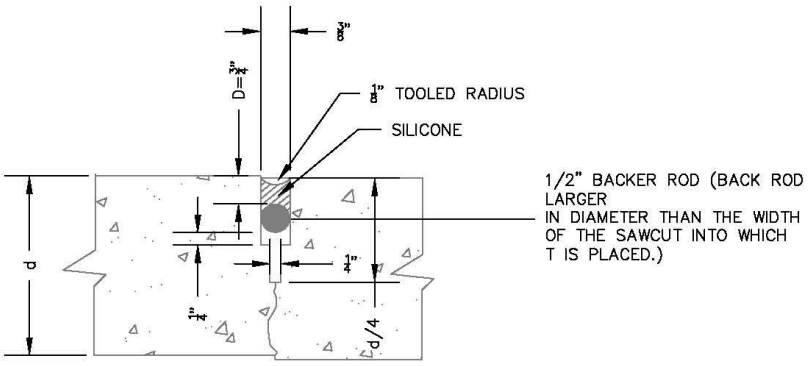



KEYWAYS FOR TYPE B AND F
CONSTRUCTION JOINT

| | | |
|---|---|---|
| Branson MISSOURI ★ Engineering & Public Works | CONCRETE PAVING JOINT DETAILS | STANDARD DRAWING 15-6 |
| | | ADOPTED 2023 / REVISION |

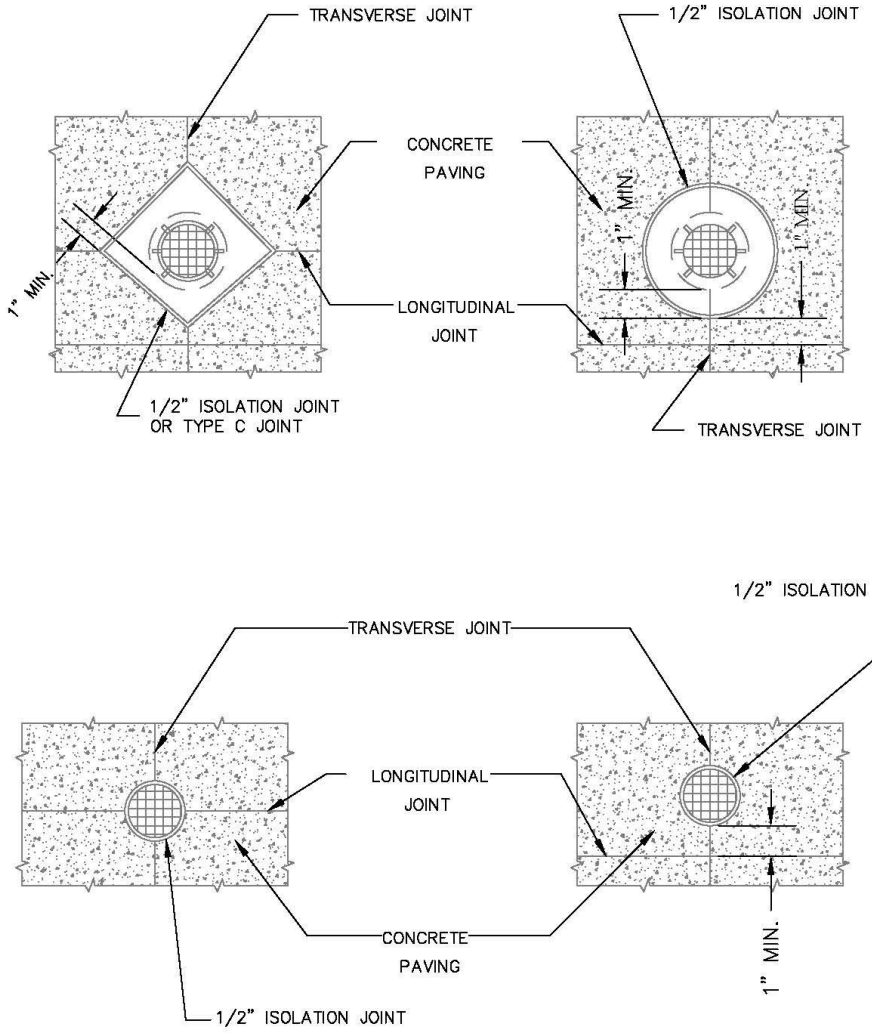
NOTE:

1. SILICONE JOINT SEALING MATERIAL SHALL BE COLD APPLIED. SINGLE COMPONENT TYPE CONFORMING TO REQUIREMENTS OF FED. SPEC, TT–S–1543, DOW CORNING "BBB SILICONE HIGHWAY JOINT SEALANT", SEALING MATERIAL SHALL BE PRESSURE MACHINE APPLIED IN ACCORDANCE WITH THE SEALING MATERIAL FURNISHED FOR THE BACKER ROD SHALL BE A RESILENT, CLOSED CELL POLYETHYLENE FOAM ROD AS RECOMMENDED BY THE MANUFACTURER OF THE SEALANT.
2. d = DEPTH OF SLAB.
3. D = DEPTH TO TOP OF BACKER ROD, DEPTH "D" SHALL ALWAYS BE TWICE THE WIDTH OF THE JOINT.




## TYPICAL SECTION

| | | | |
|---|---|---|---|
| Branson MISSOURI Engineering & Public Works | CONCRETE PAVING JOINT SEALING DETAILS | STANDARD DRAWING 15-7 | |
| | | ADOPTED 2023 | REVISION |

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|---|---|---|
| Branson MISSOURI Engineering & Public Works | CONCRETE PAVING ISOLATION JOINT DETAILS | STANDARD DRAWING 15-8 |
| | | ADOPTED 2023 / REVISION |

SECTION 2000 CONCRETE

2001 SCOPE. This section covers all cast-in-place concrete, including reinforcing steel, forms, finishing, curing, and other appurtenant work.

2002 GENERAL. All cast-in-place concrete shall be accurately formed, and properly placed and finished as shown on the drawings and specified herein. The Contractor shall inform the Engineer at least 24 hours in advance of the times and places at which he intends to place concrete.

2003 MATERIALS. All material used in the manufacture of concrete shall conform to the following:

A. Concrete Control and Quality. The current editions of the "Bulletins" and Approved Sections of the "Standard Concrete Specifications" issued by the Mid-West Concrete Industry Board, Inc. (MCIB) are made a part hereof by reference. However, when the provisions of such "Bulletins" and "Sections" differ from these specifications, the provisions of this Specification shall govern.

B. Concrete. Concrete for use in construction shall conform to the requirements of this section.

1. Cement. Portland Cement shall conform to ASTM C-150, Type I, II or III.

2. Coarse Aggregate. Coarse Aggregate shall conform to MCIB Section 4.

3. Fine Aggregate and Mixing Water. Fine aggregate and mixing water shall conform to MCIB Section 4.

4. Admixtures. Admixtures shall conform to MCIB Section 5 and ASTM 494.

C Reinforcing Steel.

1. Bars: Bars shall conform to ASTM A-615.

2. Welded Steel Wire: Welded steel wire fabric shall conform to ASTM A-185.

3. Supporting Elements. Representative samples of supporting elements shall be submitted and approved by the Engineer prior to their use in the project.

4. Fibers: Where required, fibers shall be applied at the rate of 3 pounds per cubic yard (1.8 kg per cubic meter) of concrete. Fibers for concrete reinforcement shall be composed of only 100% virgin homopolymer polypropylene, fibrillated and graded. Fibers shall contain no reprocessed olefin materials, and shall be specifically manufactured to an optimum gradation for use as secondary concrete reinforcement, meeting the requirements of ASTM C 1116, Type III, 4.1.3, and ASTM C 1116 Performance Level 1, and a minimum residual strength of 30 psi (210 kPa) per

ASTM C 1399, average of 4 beams sampled at the point of discharge (or when appropriate, the point of placement.

D. Isolation Joint Fillers: Expansion joint fillers shall conform to ASTM D-1752.

E. Joint Sealing Compounds. Joint sealing compounds shall be one or two component rubberized polysulfide urethanes conforming to Federal Specification Numbers TT-00227 or TT-00230-C.

F. Curing Membrane. All material to be used or employed in curing Portland Cement Concrete must be approved by the Engineer prior to its use. It shall be of the liquid membrane type and shall conform to one of the following:

1. A white pigmented two component water insensitive epoxy with a solid epoxy content of 40 to 60 percent. Application rate is 5 to 8 mils wet.

2. A white pigmented liquid system of styrene acrylate Type I Class 2 or liquid chlorinated rubber Type II Class 2, complying with Federal Specification No. TTC-800A. Application rate 6 to 10 mils wet.

J. Method of Applying Curing Membrane. A nozzle producing a uniform fan pattern will be used on all spray equipment when applying the liquid curing membrane.

2004 PRELIMINARY REVIEW. A report shall be submitted to the Engineer prior to the placement of concrete and shall include data on proposed concrete mix proportions and the fine and coarse aggregate gradation. Mix proportions shall be selected preferably on the basis of field experience and may be adjusted upon approval of the Engineer where required to produce concrete of proper workability, uniform consistency, and acceptable density and strength.

A tentative concrete mix shall be designed and tested for each size and gradation of aggregate and for each slump intended to be used on the work. Design quantities and test results of each mix shall be submitted to the Engineer for review and approval.

2005 CONCRETE MIX DESIGNATIONS. The following tabulation indicates minimum strengths for the various types of concrete which will be accepted.

| | Min. Compressive Strength | | |
|---|---|---|---|
| Class | 7-days | 28-days | Slump |
| I | 2000 psi | 3000 psi | 4 inches max. |
| II | 2650 psi | 4000 psi | 2-4 inches max. |

All cast-in-place or precast construction for pavements, curbs, curb and gutter, sidewalks, drive approaches, inlets, manholes, reinforced concrete boxes, bridges and as otherwise required by the Engineer shall be of Class II concrete. The use of Class I concrete shall be confined to non-structural elements such as manhole or inlet inverts and pipe encasements. When high-early strength cement is to be used for concrete, the mix shall obtain a 7-day strength not less than the

minimum 28-day strength specified for concrete of the same class.

2006 LIMITING REQUIREMENTS. Each concrete mix shall be designed and concrete shall be controlled within the following limits.

| | Max. Size Course Slump | Aggregate | Cement Content Lbs./C.Y. | Max. Water Cement Weight Ratio | Max. Gals Water per Sack of Cement |
|---|---|---|---|---|---|
| (3000 psi) Class II | 4" | 1" | 480 | .542 | 6.12 |
| (4000 psi) | 2" | 1" | 558 | .421 | 4.75 |
| | 3" | 1" | 588 | .421 | 4.75 |
| | 4" | 1" | 618 | .421 | 4.75 |

The quantity of portland cement shall be not less than that shown in the preceding table. The use of plasticizers in concrete mixes shall only be as approved by the Engineer. If an approved plasticizer is utilized in the concrete mix, the cement factor shown shall be decreased 10 percent, or as approved by the Engineer.

Concrete slump shall be kept as low as possible consistent with proper handling and thorough compaction. Maximum slump for portland cement concrete pavement shall be two inches. Slumps for concrete work other than pavement construction shall not exceed four inches. Use of slumps in excess of those specified shall be only when authorized by the Engineer. The use of water to obtain so-called "improved workability" shall not be permitted.

The initial set as determined by ASTM C403 shall be attained 5-1/2 hours, plus or minus one (1) hour, after the water and cement are added to the aggregates. If such use has been approved by the Engineer, the quantity of retarding or accelerating admixture shall be adjusted to compensate for variations in temperature and job conditions. The admixture content shall be in accordance with the recommendations of the manufacturer for compliance with these specifications.

The total volumetric air content of concrete after placement shall be six percent (6%), plus or minus one percent (1%).

The minimum acceptable compressive strengths shall be as determined by ASTM C39.

As the work progresses, the Engineer reserves the right to change the proportions from time to time if conditions warrant such changes to produce a satisfactory job. Any such changes may be made within the limits of the specifications at no additional compensation to the Contractor.

2007 BATCHING AND MIXING. Concrete shall be furnished by an acceptable ready-mixed concrete supplier and shall conform to ASTM C94.

The consistency of concrete shall be suitable for placement conditions. Aggregates shall float

uniformly throughout the mass and the concrete shall flow sluggishly when vibrated or spaded. The slump shall be kept uniform.

2008 PLACEMENT. The limits of each concrete pour shall be predetermined by the Contractor and shall be acceptable to the Engineer. All concrete within such limits shall be placed in one continuous operation.
Before concrete is placed, forms, reinforcements, and embedment's shall be rigidly secured in proper position and all dirt, mud, water and debris shall be removed from the space to be occupied by the concrete. Bonding surfaces shall be cleaned of all foreign material and shall be free from laitance. Concrete shall not be placed on frozen subgrade or in excavations which have been dewatered.

Placement of concrete shall conform to requirements of ACI 304. Concrete shall be placed within 45 minutes of mixing operations, with the exception that the Engineer may extend the period to a maximum of 90 minutes dependent upon weather conditions. Concrete shall not be placed in horizontal layers exceeding 18 inches. During and immediately after placement, concrete shall be thoroughly compacted and worked around all reinforcements and embedment's and into the corners of the forms. The concrete shall be vibrated or spaded to produce a solid mass without honeycomb or surface air bubbles.

2009 COLD WEATHER CONCRETING. Unless authorized in writing by the Engineer, mixing and concreting operations shall be discontinued when the descending air temperature in the shade and away from artificial heat reaches 40 degrees Fahrenheit or when forecast to drop below 40 degrees Fahrenheit within 24 hours of placement, and shall not be resumed until an ascending air temperature in the shade and away from artificial heat reaches 35 degrees Fahrenheit.

When concrete work is authorized during cold weather, the aggregates may be heated by methods approved by the Engineer prior to being placed in the mixer. No ingredient that is frozen or contains ice shall be placed in the mixer. The temperature of the concrete shall be not less than 60 degrees Fahrenheit and not more than 80 degrees Fahrenheit at the time of placement in the forms. Under no circumstances shall concreting operations continue when the air temperature is less than 20 degrees Fahrenheit. No concrete shall be placed on frozen subgrade. Sudden cooling of concrete shall not be permitted. Concrete injured by frost action or freezing weather shall be removed and replaced at the Contractor's expense.

2010 HOT WEATHER CONCRETING. The provisions of this section shall apply to all concrete work which is done when the air temperature is above 80 degrees Fahrenheit at the time of placement.

The temperature of the concrete, when placed, shall not be high enough to cause excessive loss of slump, flash set or cold joints. In no case shall the temperature of the concrete, when placed, exceed 90 degrees Fahrenheit. Forms, reinforcing and subgrade surfaces against which the concrete is to be placed shall be wetted down immediately before placement.

When the air temperature exceeds 90 degrees Fahrenheit and as soon as practicable without causing damage to the surface finish, all exposed concrete shall be kept continuously moist by

means of fog sprays, wet burlap, cotton mats, or other means acceptable to the Engineer. This cooling with water shall be in addition to the initial sealing by membrane curing compound.

2011 CURING AND PROTECTION. Concrete shall be cured by protecting it against loss of moisture, rapid temperature changes and mechanical injury for at least four (4) days after placement. Acceptable methods shall be moist curing, waterproof paper, white polyethylene sheeting, liquid membrane-forming compounds, or a combination thereof. After concrete finishing operations have been completed, the entire surface of the newly-placed concrete shall be covered by the curing medium applicable to local conditions and acceptable to the Engineer. The Contractor shall have the necessary equipment for adequate curing on hand and be ready to install prior to concrete placement.

Moist curing shall be accomplished by a covering of burlap or other approved fabric mat used singly or in combination. Curing mats shall be thoroughly wet when applied and kept continuously wet and in intimate contact with the surface for the duration of the moist-curing period. Burlap or fabric mats shall be long enough to cover the entire surface of the work and lapped at joints to prevent drying between adjacent sheets.

Waterproof paper or white polyethylene sheets shall be large enough to cover the entire surface of the work and shall be lapped not less than 18 inches. The sheets shall be adequately weighted to prevent displacement or billowing due to wind. Tear holes appearing in the material during the curing period shall be immediately repaired or replaced with material in acceptable condition.

White membrane curing compound shall be applied after finishing operations have been completed and immediately after the free water has left the surface. The surface of the work shall be completely coated and sealed with a uniform layer of the curing compound at a rate of not less than one gallon per 150 square feet. The compound shall not be thinned and shall be kept agitated to prevent settlement of pigment. On surfaces where forms are removed prior to the end of the specified curing period, the entire exposed surface shall be coated at the specified rate of coverage. If rain falls on the newly-coated surface before the film dries sufficiently to resist damage, or if the film is damaged in any other way, the Contractor will be required to apply a new coat of compound to the affected area.

During cold weather concreting when the ambient air temperature is expected to drop below 40 degrees Fahrenheit, sufficient supply of burlap, straw, hay, or other blanketing material shall be provided along the work to protect the concrete and maintain a minimum temperature of 40 degrees F in the concrete as measured on the surface. An approved moisture barrier such as wet burlap or plastic sheeting shall be placed on the concrete prior to placement of the blanketing material. This type of curing shall be maintained for a period of six (6) days as the initial cure.

Sidewalks, curb and gutter, and miscellaneous concrete shall be protected and cured for a period of not less than 72 hours after the placing of the concrete by covering with wet burlap or by the application of a membrane curing compound as specified above.

2012 FORMS. Forms shall be designed to produce hardened concrete having the shape, lines,

and dimensions shown on the drawings. They shall be sufficiently tight to prevent leakage of mortar and shall be braced or tied to maintain the desired position, shape, and alignment during and after concrete placement.

Forms may be of wood or metal and shall be designed to permit easy removal without injury to the concrete. Forms for all exterior exposed surfaces which will be visible after backfilling shall be prefabricated plywood panel forms, job-built plywood forms, or forms that are lined with plywood or fiberboard. Forms shall be coated with an approved light oil to prevent concrete from adhering and shall be thoroughly cleaned and re-oiled before re-use.

Forms shall not be removed or disturbed until the concrete has attained sufficient strength to safely support all dead and live loads. Care shall be taken in form removal to avoid surface gouging, corner or edge breakage, and other damage to the concrete. The following table gives the approximate minimum time that forms shall be left in place.

| Average Air Temperature Greater Than | 70 Deg | 60 Deg | 50 Deg | 40 Deg |
|---|---|---|---|---|
| Structural Member | Time in Place (24 Hour Days) | | | |
| Slab Shoring | 10 | 12 | 14 | 21 |
| Slab Forms | 7 | 7 | 7 | 7 |
| Beams Soffits and Shoring | 10 | 12 | 14 | 21 |
| Beam Side Forms | 1 | 1 | 2 | 3 |
| Wall Side Forms | 2 | 2 | 3 | 4 |

2013 FINISHING FORMED SURFACES. Fins and other surface projections shall be removed from all formed surfaces except exterior surfaces that will be in contact with backfill. A power grinder shall be used, if necessary, to remove projections and provide a flush surface. Surfaces to be damp proofed shall have fins removed and tie holes filled, but no additional finishing will be required.

Tie holes in all formed surfaces shall be cleaned, wetted, and filled with patching mortar. Tie hole patches shall be finished flush and shall match the texture of the adjacent concrete.

2014 REPAIRING DEFECTIVE AND DAMAGED CONCRETE. Any concrete found not to be formed as indicated on the plans, or out of alignment or level, or having a defective surface, or damaged prior to acceptance of the project by the City, shall be considered as not conforming to the intent of these specifications and may be ordered removed and replaced by the contractor at his expense unless the Engineer authorizes patching of the defective or damaged area. Surface

defects such as ridges and bulges shall be removed by grinding. Honeycombed and other defective concrete that does not affect the structural integrity of the structure shall be chipped out and the vacated area shall be filled. The methods used in this type of repair shall be approved by the Engineer. Material used for patching shall be a non-shrink, non-metallic grout with a minimum 28-day compressive strength of 5000 psi or a similar material approved by the Engineer. Prior to placement of the repair filling, the contact surface of the affected area shall be thoroughly cleaned of all loose and foreign material and shall be coated with an epoxy bonding agent.

Concrete repair work shall conform to Chapter 9 of ACI 301 and shall be performed in a manner that will not interfere with thorough curing or surrounding concrete. Repair work shall be adequately cured and protected from further damage.

2015 REINFORCEMENTS. The metal reinforcement shall be protected by the thickness of concrete indicated on the construction drawings. Where not otherwise shown, the thickness of concrete over the reinforcement shall be as follows:

| Location of Reinforcement | Cover in Inches |
|---|---|
| Surfaces where concrete is deposited directly against the ground. | 3 |
| Formed surfaces exposed to the ground, to water, or to weathering. | 2 |
| Beams, girder, and columns not exposed to ground, water, or weathering. | 1-1/2 |
| All surfaces other than those above. | 1 |

Reinforcing steel shall be accurately placed and positioned on supports, spacers, hangers, or other reinforcing steel as approved by the Engineer and shall be secured in place with wire ties or suitable clips. The minimum clear distance between parallel bars shall not be less than 1-1/2 times the diameter of round bars, except that in no case shall clear spacing between parallel bars be less than two inches (2") or less than 1-1/2 times the nominal size of the coarse aggregate.

Splices in reinforcing steel will not be permitted at points of maximum stress. When it becomes necessary to splice reinforcing steel at points other than those shown on the contract drawings, the character and location of the splice shall be approved by the Engineer. Welding or tack welding of reinforcement will not be permitted. Reinforcements upon which unauthorized welding has been done shall be removed and replaced as directed by the Engineer. Spliced bars shall be placed in contact and securely tied together.

Metal reinforcement at the time concrete is placed shall be free from rust, scale, or other contaminants that will destroy or reduce the bond.

2016 CONSTRUCTION JOINTS. Construction joints shall be made at locations indicated on

the drawings or specified, and shall conform to the requirements of ACI 318. When the Contractor desires to make construction joints at other locations, he shall anticipate such changes far enough in advance of the construction operations to allow the Engineer to investigate such changes and approve additional construction joints.

2017 EXPANSION AND CONTRACTION JOINTS. Expansion and contraction joints shall be at locations indicated on the drawings or as specified.

Contraction joints shall consist of planes of weakness created by forming or cutting grooves in the surface of the concrete. Formed grooves shall be made by depressing an approved tool or devise into the plastic concrete. Sawed joints shall be constructed by sawing through the surface of the concrete with an approved concrete saw. Sawing of the joints shall begin as soon as the concrete has hardened sufficiently to prevent excessive raveling.

Expansion joints shall be formed with pre-formed expansion joint filler of the non-extruding and resilient types which shall include the following; Cork, self-expanding cork, sponge rubber, cork rubber, and bituminous fiber. These materials shall meet the requirements of ASTM D994, D1751 and D1752.

2018 REINFORCED CONCRETE BOX FORMING SEQUENCE. Wall forms may be placed the day following the placement of the bottom slab, as long as care is taken to protect the slab against rough or abusive handling of forms and or placing equipment. The actual placement of concrete shall not occur prior to the fifth day after placing the bottom slab. Top forms may be placed with wall forms if the walls and top are to be monolithic construction, otherwise top forms are not to be placed until the third day after placing the walls. The actual placement of concrete for the top shall not occur prior to the fifth day after placing the walls (for base to top shoring) or until the walls have reached their design minimum of two days after the walls are poured. Wall forms shall remain in place a minimum of two (2) days after the walls are poured. Supports for the top slab shall be left in place according to the schedule shown on page 20-5, Section 2012, Forms.

The above guidelines for placing forms for reinforced concrete boxes are based on the use of standard forming procedures and with the use of concrete containing no admixtures to achieve high early strength. Variations in forming techniques and/or the use of high early strength concrete shall only be allowed after the contractor obtains the written approval of the director of public works/engineering.

SECTION 2100 CONCRETE CURB AND CURB AND GUTTER

2101 SCOPE. This section governs the furnishing of all labor, equipment, tools, and materials and the performance of all work necessary to construct or reconstruct curbing and/or curb and gutter.

2102 MATERIALS. All items of material included in this section shall conform to Section 2000 except as follows:

A. Concrete Mix. Concrete shall conform to the requirements set forth for Class II mix design. Slump shall be approved by the Engineer.

B. Expansion Material. Expansion material shall be a preformed, one-piece, non-extruding material such as "Bondex" No. 941 pre-formed rubber joint, "Rubatex" both manufactured by Rubatex Co., or "Homex" as manufactured by Homasote Co. or equal. Any substitute material requires the approval of the Engineer.

C. Joint Sealer. Joint sealer shall be a one component, gun-grade, moisture cured epoxy or urethane such as "Vulcum 45" as manufactured by Maneco International, "Sidaflex 1-A" by Sika Chemical Corporation or "Pecora CG-9" by Pecora Co., or equal as approved by the Engineer.

D. Curing Membrane. Curing membrane shall be as specified in Section 2003 (F).

2103 CONSTRUCTION DETAILS. The curbing shall be constructed or reconstructed to the configuration and to the lines and grades shown on the plans. Generally, the curbing shall be placed prior to the placement of pavement or sidewalk sections, except when curb and gutter is integral with the pavement, and as directed by the Engineer.

A. Removal of Existing Curbing for Reconstruction. Existing curbing shall be totally removed to the nearest contraction or expansion (isolation) joint or with the approval of the Engineer it may be sawed provided no free section is left that is less than 5 lineal feet in length, and provided the entire curbing section is sawed a minimum of 2 inches below any exposed surface, or sufficiently to prevent disturbance or damage to all adjacent structures or slabs, whichever is greater

B. Grading and Subgrade Preparation. All excavation or embankment shall conform to these Technical Specifications; and as follows:

The top six inches (6”) of the subgrade shall be compacted to obtain a density of 95 percent of the maximum in conformance with Section 1205(A). If during reconstruction operations, additional fill material is needed beneath the curb, it shall be of crushed limestone, placed in lifts of 4 inches not to exceed 12 inches maximum thickness, moistened if necessary, and compacted by mechanical tampers to a density of 95 percent of the maximum.

C. Forms: All forms shall be in good condition, clean, and free from imperfections. Each form shall not vary more than 1/4 inch in horizontal and vertical alignment for each 10 feet in length. Face forms will be used when feasible. Forms shall have a height equal to or greater

than the height of the curb face being formed. The forms shall be set true to line and grade and shall be supported to stay in position while depositing and consolidating the concrete. The forms shall be designed to permit their removal without damage to the concrete. The forms shall be lubricated.

D. Slip-Form Curb Machine. A slip-form curb machine may be used in lieu of forms. The machine must be equipped with mechanical internal vibrators and be capable of placing curb to the correct cross section, line and grade within the allowable tolerances.

2104 JOINTS. The joints shall be formed at right angles to the alignment of the curbing and to the depth specified by the appropriate standard or as modified by the plans.

A. Isolation Joints. Isolation joints shall be placed at all radius points, driveways, curb inlets, or where directed by the Plans or Engineer.

1. Material. Isolation joints shall be formed by a one piece, 1-inch-thick preformed joint filler cut to the configuration of the correct curb section.

2. Stability. Isolation joints shall be secured in a manner so they will not be disturbed by depositing and consolidation of concrete.

3. Edging. The edges of the joints shall be rounded with an edging tool of 1/4-inch radius.

B. Contraction Joints: Curbing shall have contraction joints at intervals of not less than 10 feet or more than 15 feet. They shall extend through the entire curb section from the top of the curb to a depth 2 inches below pavement surface.

1. Method. Contraction joints may be formed or sawed.

a. When sawing joints, the contractor shall begin as soon as the concrete hardens sufficiently to prevent excessive raveling along the saw cut and shall finish before conditions induce uncontrolled cracks, regardless of the time or weather. When joint sealing backup material is specified with sawed joints, the first stage, which provides a relief cut shall be approximately 1/8-inch-wide, and shall be to Plan depth. The second stage which widens the joints to allow the insertion of joint sealing backup material to Plan depth shall not be performed until the concrete is at least 48 hours old, and shall be delayed longer when the sawing causes raveling of the concrete. If second stage sawing is performed prior to the completion of the curing period, the Contractor shall maintain the cure by use of curing tapes, plastic devices, or other materials approved by the Engineer.

b. When forming joints, templates shall be 1/8” metal cut to the configuration of the curbing section. The templates shall be secured at the proper locations so that they will not be disturbed by the depositing of concrete. The templates shall be removed as soon as the concrete has attained its initial set and

finished with a ¼ inch radius on all exposed edges.

2. Joint Sealer When specified, joint sealant shall conform to Section 2003.

2105 CONCRETE WORK. Concrete for curbing shall be placed in accordance with the requirements of MCIB Standard Concrete Specifications. Isolation and contraction joints shall be constructed as shown on the Plans, Standard Drawings, or where directed by the Engineer.

A. Concrete Placement. Concrete shall be mechanically vibrated and shall not be allowed to extrude below the forms to cause an irregular alignment of the abutting street pavement.

B. Finishing. After placing and initial strike-off the curb shall be tooled to the required radii. If the surface of the concrete is sufficiently wet that a ridge is formed at the inside of the radius tool, finishing will cease until the excessive moisture has evaporated.

After initial set, the face forms and templates, if used, shall be removed and the surface finished to the required dimensions. No water, dryer, or additional mortar shall be applied to the free surface of the concrete.

The finished surface of the concrete shall be broomed perpendicular to the curb with a clean broom to provide an antiskid surface.

In all cases the finished curb shall have a true surface, free from sags, twists, or warps, and shall have a uniform color and appearance.

C. Curing. As soon as practical after the concrete is finished it shall be cured with one of the acceptable liquid curing membranes applied according to the manufacturer's directions.

If front and/or back forms are removed from finished curbing within a period of 72 hours of placement these surfaces shall also be cured.

Wet burlap, cotton mat, waterproof paper, polyethylene sheeting or earth backfill is not an acceptable curing method for curbing.

D. Protection. The Contractor shall protect the concrete work against damage or defacement of any kind until it has been accepted by the City. Concrete which is damaged or defaced, shall be removed and replaced, or repaired to the satisfaction of the City, at the expense of the Contractor.

E. Temperature Limitations. Concrete work shall be placed in accordance with requirements of these Technical Specifications and MoDOT Construction Standards.

2106 BACKFILL. A minimum of 24 hours shall lapse before forms are removed and curb sections are backfilled unless otherwise approved by the Engineer. Backfill shall be accomplished in accordance with these Technical Specifications".

The Contractor shall be responsible for the repair of any street pavement disturbed by the construction to the satisfaction of the Engineer.

2107 JOINT SEALING AND CLEAN-UP. Only the sidewalk portion of the curbing will require joint sealing. An approved joint sealer shall be applied in accordance with the manufacturer's directions within seven (7) days of the placement of the concrete. The Contractor shall be responsible for the removal of excess dirt, rock, broken concrete, concrete splatters and overspray from the area of construction.

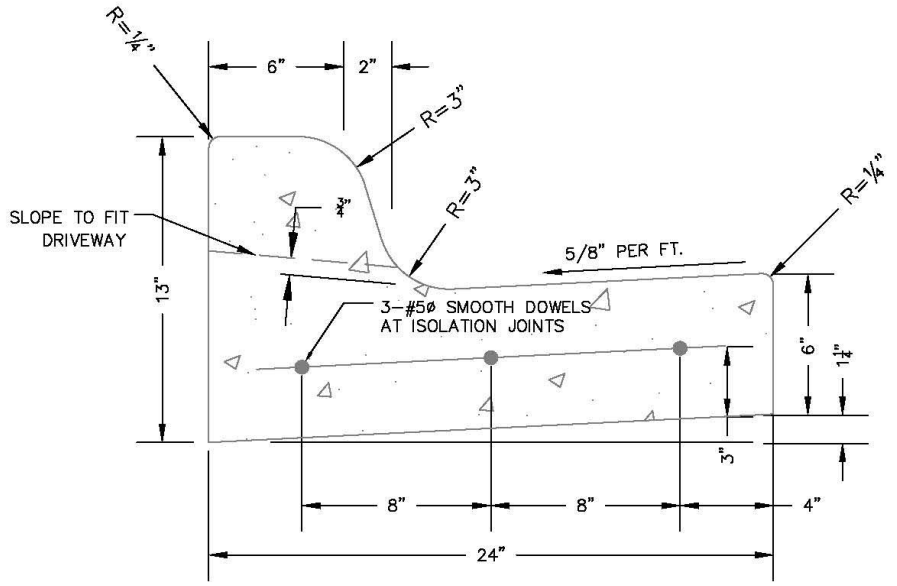
2108 SURFACE TOLERANCES. Curbing shall have a surface tolerance of 1/4 inch in 10 feet when checked with a ten-foot straightedge.

2109 REINFORCEMENT (CURB AND GUTTER). Reinforcement for concrete curb and gutter shall be as designated on the Standard Detail Drawings. The exception to this shall be when the curb and gutter is to be constructed on an asphaltic concrete base with a minimum depth of three inches (3"). In this case, no reinforcement shall be required unless otherwise determined by the City Engineer.

2110 REINFORCEMENT (OTHER). Reinforcement for all other work shall be as shown on the contract drawings or as depicted on details contained in this specification.

NOTES:

1. ISOLATION JOINTS SHALL BE FORMED BY ONE–HALF (1/2) INCH JOINT FILLER, CUT TO THE CONFIGURATION OF THE FULL SIZE OF THE CURB AND GUTTER SECTION AND BEING SECURED SO THAT THEY ARE NOT MOVED BY DEPOSITING AND COMPACTING THE CONCRETE AT THESE JOINTS. THE EDGE OF THESE JOINTS SHALL BE ROUNDED WITH AN EDGING TOOL ONE–EIGHTH (1/8) INCH RADIUS.
2. ISOLATION JOINTS SHALL BE PLACED WHERE CURB AND GUTTER ABUTS OTHER STRUCTURES AND AT ALL TANGENT POINTS TO CURB. EXPANSION JOINTS SHALL NOT BE SPACED MORE THAN 50 FEET APART ON STRAIGHT RUNS FOR HANS LAID CURB AND GUTTER AND NOT MORE THAN 100 FEET APART FOR MACHINE LAID CURB AND GUTTER PROVIDED 1/2 INCH THICK JOINT FILLER IS USED. ALL JOINTS SHALL BE FORMED AT RIGHT ANGLES TO THE ALIGNMENT OF THE CURB AND GUTTER.
3. CONTRACTION JOINTS SHALL BE CONSTRUCTED BY SAWING THROUGH THE CURB AND GUTTER TO A DEPTH OF NOT LESS THAN TWO (2) INCHES BELOW THE SURFACE AND TO A WIDTH NOT TO EXCEED THREE–EIGHTS (3/8) INCH OR THEY MAY BE FORMED BY INSERTING A REMOVABLE METAL TEMPLATE IN THE FRESH CONCRETE, OR BY OTHER METHODS APPROVED BY THE ENGINEER. SEALING OF JOINTS IS NOT REQUIRED. CONTRACTION OR CONSTRUCTION JOINTS SHALL BE LOCATED APPROXIMATELY 10 FEET APART.

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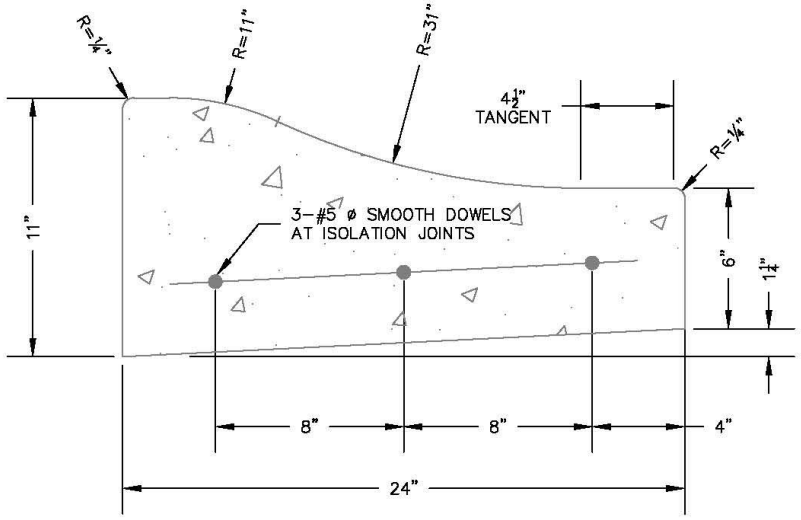
| Branson MISSOURI ★ Engineering & Public Works | STRAIGHT-BACK TYPE "CG-1" CURB AND GUTTER DETAIL | STANDARD DRAWING 21-1 | |
| | | ADOPTED 2023 | REVISION |

NOTES:

1. ISOLATION JOINTS SHALL BE FORMED BY ONE–HALF (1/2) INCH JOINT FILLER, CUT TO THE CONFIGURATION OF THE FULL SIZE OF THE CURB AND GUTTER SECTION AND BEING SECURED SO THAT THEY ARE NOT MOVED BY DEPOSITING AND COMPACTING THE CONCRETE AT THESE JOINTS. THE EDGE OF THESE JOINTS SHALL BE ROUNDED WITH AN EDGING TOOL ONE–EIGHTH (1/8) INCH RADIUS.
2. ISOLATION JOINTS SHALL BE PLACED WHERE CURB AND GUTTER ABUTS OTHER STRUCTURES AND AT ALL TANGENT POINTS TO CURB. EXPANSION JOINTS SHALL NOT BE SPACED MORE THAN 50 FEET APART ON STRAIGHT RUNS FOR HANS LAID CURB AND GUTTER AND NOT MORE THAN 100 FEET APART FOR MACHINE LAID CURB AND GUTTER PROVIDED 1/2 INCH THICK JOINT FILLER IS USED. ALL JOINTS SHALL BE FORMED AT RIGHT ANGLES TO THE ALIGNMENT OF THE CURB AND GUTTER.
3. CONTRACTION JOINTS SHALL BE CONSTRUCTED BY SAWING THROUGH THE CURB AND GUTTER TO A DEPTH OF NOT LESS THAN TWO (2) INCHES BELOW THE SURFACE AND TO A WIDTH NOT TO EXCEED THREE–EIGHTS (3/8) INCH OR THEY MAY BE FORMED BY INSERTING A REMOVABLE METAL TEMPLATE IN THE FRESH CONCRETE, OR BY OTHER METHODS APPROVED BY THE ENGINEER. SEALING OF JOINTS IS NOT REQUIRED. CONTRACTION OR CONSTRUCTION JOINTS SHALL BE LOCATED APPROXIMATELY 10 FEET APART.

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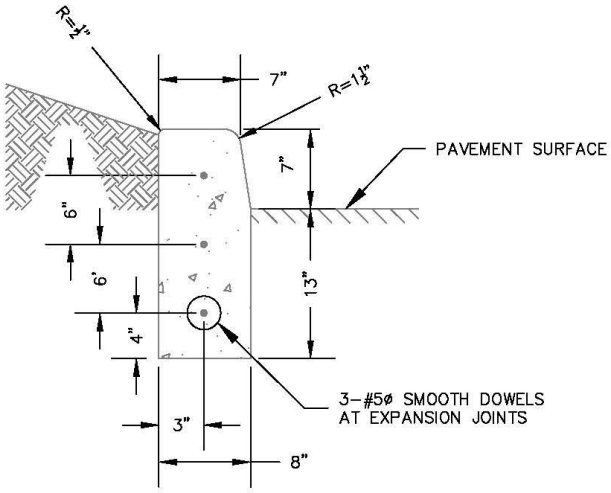
| Branson MISSOURI ★ Engineering & Public Works | ROLL-BACK TYPE "CG-2" CURB AND GUTTER DETAIL | STANDARD DRAWING 21-2 |
| | | ADOPTED 2023 / REVISION |

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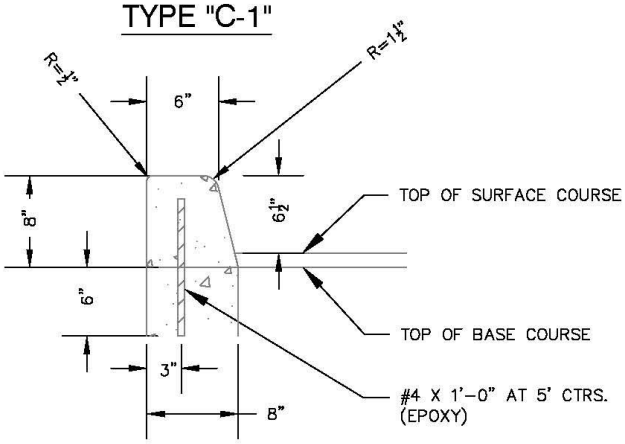


TYPE "DC"

NOTE:
1. EXPANSION, CONTRACTION, OR CONSTRUCTION JOINTS ARE TO BE SAME AS NOTED ON TYPE "CG–1" CURB AND GUTTER DETAIL.
2. ALL CURBS MUST BE CAST IN PLACE.
3. TYPE "CG–1" CURB AND GUTTER CAN ALSO BE USED IN PARKING LOT CONSTRUCTION.

| Branson MISSOURI ★ Engineering & Public Works | PARKING LOT CONCRETE CURBING | STANDARD DRAWING 21-3 | |
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| | | ADOPTED 2023 | REVISION |

# SECTION 2200 STANDARD SIDEWALKS AND DRIVEWAYS

2201 SCOPE. This section governs the furnishing of all labor, equipment, tools, material, and the performance of all work necessary to construct or reconstruct sidewalks and driveways. The latest standards shall be used. If conflicting standards exist, the more stringent standard shall apply.

2202 MATERIALS. All items of material included in this section shall conform in general to the requirements of Section 2000, "Concrete" for Class II concrete.

A. Concrete Mix. Concrete shall conform to the requirements. Concrete shall conform to Section 2000 except that limestone meeting the requirements of MCIB Section 1 may be used as coarse aggregate and shall have a design strength of 4,500 psi or greater. When the ambient air temperature is 90 degrees Fahrenheit. or higher, a retarder will be used in all concrete mixes.

   If MoDOT specifications are referenced, provide material in compliance with the latest version of MoDOT specifications. Approval of component materials will be based on submittal of certifications from supplier. Aggregates shall meet the quality requirements specified by MoDOT. Engineer reserves the right to perform testing of components to verify compliance.

B. Reinforcement.: Reinforcement is not required unless shown on the Plans, Standard Drawings or in the Special Provisions. If specified to be used, reinforcement shall meet the following requirements:

   1. Bars: Non-epoxy coated bars shall conform to ASTM A 615. Epoxy coated bars shall conform to ASTM A 775.

   2. Welded Steel Wire: Welded steel wire fabric shall conform to ASTM A 1064.

   3. Supporting Elements: Representative samples of supporting elements shall be submitted and approved by the Engineer prior to their use in the project

   4. Fibers: When specified in the Contract Documents, fibers shall be incorporated into the concrete at the rate recommended by the manufacturer but no less than a minimum of 3 pounds per cubic yard of concrete for macro fibers and 1 pound per cubic yard of concrete for micro fibers. Micro fibers are used to control plastic shrinkage cracks in concrete while macro fibers control cracking in hardened concrete and are often used as a substitute for traditional crack control steel reinforcing bars or mesh. In addition, macro fibers add toughness, and impact and fatigue resistance to hardened concrete.

2203 CONSTRUCTION DETAILS. The sidewalks or driveways shall be constructed or reconstructed to the configuration, and to the lines and grades indicated by the plans. Generally, sidewalks and driveways should be constructed after the curbing if applicable.

A. Removal. Existing sidewalks, sidewalk ramps, driveways, or bicycle/pedestrian paths shall be totally removed to the nearest contraction or isolation joint, unless otherwise specified by the Engineer. The section shall be sawed full depth.

B. Grading and Subgrade Preparation. All excavation or embankment required in the grading or subgrade preparation shall be defined in the Sections 1100 and 1200, except as follows:

The top six inches (6") of the subgrade shall be compacted to obtain a density of 95 percent of maximum in conformance with Section 1205(A).

If during reconstruction operations additional fill material is needed beneath sidewalks or driveways it shall be of crushed limestone base rock, placed in maximum lifts of four inches (4"), moistened if necessary, and compacted by mechanical tampers to a density of 95 percent of the maximum.

C. Forms. All forms shall be in good condition, clean, and free from imperfections. Each form shall not vary more than 1/4 inch in horizontal or vertical alignment for each 10 feet in length.

1. Material & Size: Forms shall be made of metal unless otherwise approved by the Engineer and shall have a height equal to or greater than the depth of the sidewalk, driveway, or bicycle/pedestrian path section. Wood forms may be substituted when approved by Engineer and if they are free from warp with sufficient strength for the intended application.

2. Strength: Forms shall be of such cross–section and strength, and so secured as to resist the pressure of the concrete when struck off, vibrated, and finished, and the impact and vibration of any equipment which they may support.

3. Installation. The forms shall be set true to line and grade, supported through their length and joined neatly in such a manner that the joints are free from movement in any direction.

4. Preparation: Forms shall be cleaned and lubricated prior to each use and shall be so designed to permit their removal without damage to the new concrete.

2204 JOINTS. Unless directed by the Engineer the joints shall be formed at right angles to the alignment of the sidewalk or driveway, and to the configuration specified by the Plans or Standard Drawings.

A. Joint Patterns.

1. Sidewalks. Sidewalk surfaces shall be marked with a transverse joint spaced at a distance equal to the width of the sidewalk. Sidewalks greater than six feet (6') in width shall be divided by longitudinal joints spaced not less than 30 inches nor more than 60 inches with transverse joints spaced to form a square pattern. Edger tool marks shall remain showing. Curb joints should align with sidewalk joints where they abut.

2. Wide driveways. Concrete driveways and bicycle/pedestrian paths shall have a maximum slab dimension no greater than 10 feet, although widths no more than 24 times the slab thickness will be permitted to match existing joint patterns.

B. Isolation Joints. Isolation joints shall be placed where directed by the plans or Engineer. The isolation joints shall be located to give the sidewalk or driveway an appearance of continuity.

1. General. The preformed expansion joint material shall either be left 1/2 inch below the surface, or a suitable tear strip will be provided to allow for the application of the joint sealer.

2. Material. Expansion joints shall be formed by a one (1) piece, 1/2 inch preformed joint filler cut to the configuration of the correct section. The filler material shall be as specified in Section 2003 (D).

3. Stability. Expansion joints shall be secured in a manner so they will not be disturbed by depositing and consolidating the concrete.

4. Edging. The edges of these joints shall be rounded with an edging tool of 1/4-inch radius.

5. Spacing: Isolation joints shall be placed at spacing indicated on the Plans or Standard Drawings. Spacing should not exceed 100' from center to center

C. Contraction Joints. Contraction joints or false joints shall be 1-inch deep by 1/8-inch-wide with 1/4 inch radii edging.

1. Edging. Edger marks or "Ribbons" shall remain showing.

2. Contraction Joints. Contraction joints may be sawed with the approval of the Engineer at a rate of 1/8-inch wide by 1/3rd the thickness of the slab

3. Joint Sealer. Joint Sealer is not required, unless otherwise specified in the Plans, Standard Drawings or Special Provisions

2205 CONCRETE WORK. Concrete work for sidewalks and driveways shall be placed in accordance with the requirements of MCIB Standard Concrete Specifications. Joints shall be constructed as in this section or as modified by the plans or special provisions.

A. Concrete Placement. Deposit and consolidate concrete as close to the final position as possible, beginning at one corner of the forms. Perform necessary hand spreading with shovels or come– along, not with rakes or vibrators. All concrete shall be well vibrated unless approved otherwise by the Engineer. Do not walk in the fresh concrete with boots or shoes coated with earth or foreign substances. When concrete is placed on a sloped surface, begin concrete placement at the lowest area. Limitations for time of placement and other items not specifically covered by this specification shall be in accordance with the most recent Standard Specifications of the State Department of Transportation for the state the work is being performed in. The Engineer may extend placement time limitations based on field conditions and concrete consistency and workability.

B. Finishing. Strike off the concrete with a vibratory screed or a hand strike–off method when adequate consolidation is attained. Immediately after strike–off, the concrete may be bull-floated to remove any high or low spots. Minimize the use of the bull-float.

Do not finish concrete with water standing on the surface. All edges of the slab shall be carefully finished with a 1/4-inch radius edger.

After finishing, the surface of the concrete shall be broomed with a fine clean broom to provide an antiskid surface, and the edges and joints retooled.

In all cases the finished sidewalk or driveway shall have a true surface, free from sags, twists, or warps, and shall have a uniform color and appearance.

C. Curing. As soon as practical after the concrete is finished it shall be cured with one of the acceptable liquid curing membranes applied according to manufacturer's directions.

If forms are removed from sidewalks or driveways within a period of 72 hours of placement those surfaces shall also be cured.

Wet burlap, cotton mats, waterproof paper, polyethylene sheeting or earth backfill shall not be acceptable as curing methods for sidewalks or driveways.

D. Protection. The Contractor shall protect the concrete work against damage or defacement of any kind until it has been accepted by the City. Concrete which is damaged or defaced, shall be removed and replaced or repaired to the satisfaction of the Engineer, at the expense of the Contractor.

E. Temperature Limitations. Concrete shall be placed in accordance with requirements of these Technical Specifications.

2206 BACKFILL. A minimum of 24 hours shall lapse before forms are removed and sidewalks or driveways are backfilled unless otherwise approved by the Engineer.
Backfill shall be accomplished in accordance with Sections 1100 and 1200.
The Contractor shall be responsible for the repair of any street pavement disturbed by the construction.

2207 JOINT SEALING AND CLEAN-UP. All expansion joints shall be sealed with an approved joint sealer applied in accordance with Section 2003 within seven (7) days of the placement of the concrete.
The Contractor shall be responsible for the removal of excess dirt, rock, broken concrete, splatters and overspray from the area of the construction within 10 days of the date of placement.

2208 SURFACE TOLERANCES. Sidewalks or driveways shall have a surface tolerance of 1/4 inch in 10 feet when checked with a 10-foot straightedge.

2209 PAVEMENT. It is anticipated that parking lots and entrance drives will be constructed of asphaltic concrete wearing surface placed over a base. The base may be either a "black" base or a crushed limestone granular base. The minimum recommended thickness of asphaltic concrete wearing surface is two and a half inches (2.5"). The mix should meet the requirements of the Missouri State Highway Department, Standard Specifications for a BP-1 asphaltic concrete pavement as described in Section 401.3.1. The base can be constructed of crushed limestone rolled stone meeting the requirement of State specification 1007.1 for Type 1 or Type 2 aggregate. This material should be placed in two (2) lifts with each lift compacted to 100% of maximum Standard Proctor Compaction (ASTM D 698). Crushed stone base course may be replaced by asphaltic course using a substitution ratio of one inch (1") of asphaltic base for each two inches (2") of crushed stone.

2210 DETECTABLE WARNING (TRUNCATED DOME). Truncated domes and all related installed surfaces to be installed according to manufacturer's specifications. **All detectable warning surface installations shall be at minimum, at least as nonskid as the surrounding pedestrian surfaces.**

Truncated dome material specifications:

A. Chemical Resistance -- Seven (7) day immersion test:

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| Motor oil.. | no effect |
| Transmission fluid | no effect |
| Diesel fuel | no effect |
| Anti-freeze.... | no effect |
| Gasoline | no effect |
| Road salts | no effect |

B. Skid Resistance – Minimum 45 (ASTM E303) in units (British pendulum)

C. Reflectivity – 200 millicandella minimum initial reading.

D. Composition – Comprised of resins, reactive monomers, pigments, glass beads, and fillers. Exact composition is as the manufacturer's discretion. The material must be resistant to ultra-violet light.

E. Substrate Requirements:

1. Asphalt: Asphalt surfaces shall be composed of oil based bitumen. Asphalt must cure a minimum of 20 days prior to truncated dome installation to insure proper bonding of all surfaces. Any asphalt areas requiring detectable warning installations shall be compacted with vibratory rollers or approved compaction equipment to provide maximum compaction of asphalt allowing the greatest adhesion.

2. Seal Coat: Truncated dome products shall not be placed on asphalt or coal tar sealers. If surface has been sealed, grind entire area to be installed to remove all sealers.

3. Concrete: Minimum compressive strength 3000 PSI. Concrete must cure for 15 days prior to truncated dome installation to insure proper bonding. All concrete coloring/additives shall be integral, not surface applied. All "surface curing" compounds or sealers shall be removed by method of grinding on any concrete that is less than six (6) months old before truncated dome products are installed. Surface finish should be medium broom finish for maximum adhesion.

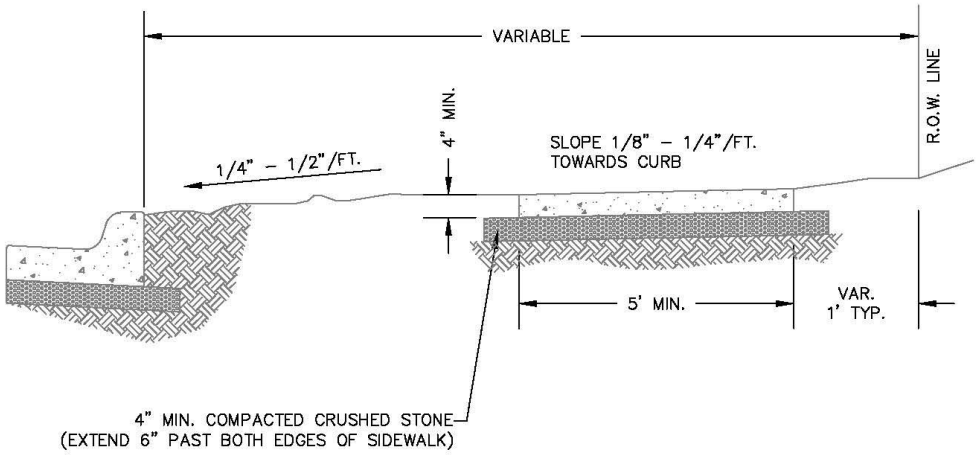
4. Surfaces: All surfaces to be clean and dry.

5. Temperatures: Surface temperatures should not exceed 88 degrees Fahrenheit, or be below 35 degrees Fahrenheit.

F. Detectable warning surfaces must be "black" in color unless otherwise approved by the director of public works/ engineering.

NOTES:

1. JOINTS SHALL BE FORMED AT RIGHT ANGLES TO THE ALIGNMENT OF THE SIDEWALK AND TO THE DEPTHS INDICATED BELOW.
2. THE SIDEWALK SHALL BE MARKED OFF INTO SQUARE STONES BY CONTRACTION JOINTS. CONTRACTION JOINTS SHALL BE ONE–EIGHT (1/8) INCH WIDE BY ONE (1) INCH DEEP WITH ONE–FOURTH (1/4) INCH RADII EDGING AND SHALL BE FORMED BY TOOLING.
3. ISOLATION JOINTS SHALL BE FORMED BY A ONE–HALF (1/2) INCH THICK PERFORMED JOINT FILLER, EXTENDING THE FULL DEPTH OF THE SLAB, AND SECURED SO THAT THEY ARE NOT MOVED BY DEPOSITING AND COMPACTING THE CONCRETE AT THESE JOINTS.
4. ISOLATION JOINTS SHALL BE PLACED WHERE SIDEWALK ABUTS OTHER STRUCTURES AND SHALL NOT BE SPACED MORE THAN 50 FEET APART ON STRAIGHT RUNS FOR HAND LAID SIDEWALK AND NOT MORE THAN 100 FEET APART ON STRAIGHT RUNS FOR MACHINE LAID SIDEWALKS.

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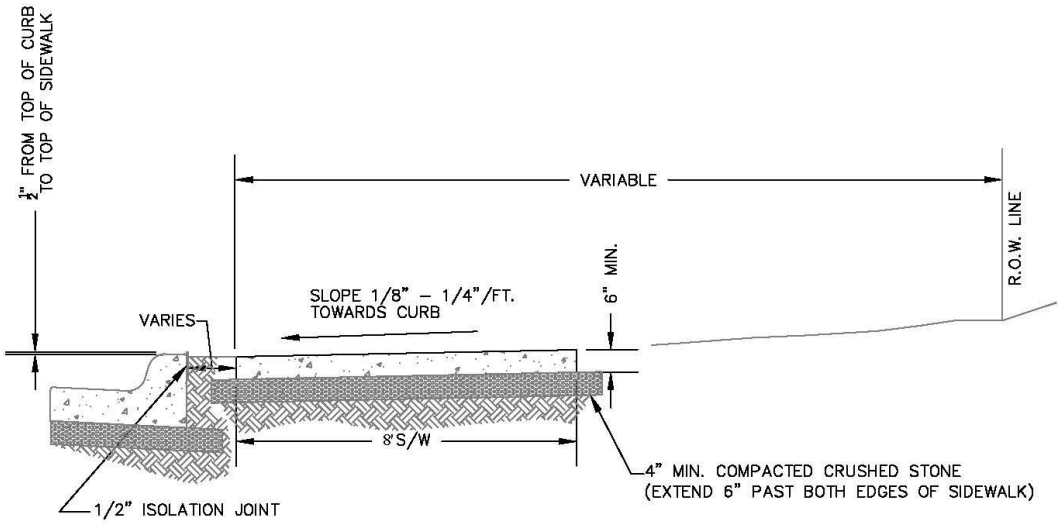
| Branson MISSOURI ★ Engineering & Public Works | 5' CONCRETE SIDEWALK DETAIL | STANDARD DRAWING 22-1 | |
| | | ADOPTED 2023 | REVISION |

NOTES:

1. JOINTS SHALL BE FORMED AT RIGHT ANGLES TO THE ALIGNMENT OF THE SIDEWALK AND TO THE DEPTHS INDICATED BELOW.
2. THE SIDEWALK SHALL BE MARKED OFF INTO SQUARE STONES BY CONTRACTION JOINTS. CONTRACTION JOINTS SHALL BE ONE–EIGHT (1/8) INCH WIDE BY ONE (1) INCH DEEP AND SHALL BE FORMED BY TOOLING.
3. ISOLATION JOINTS SHALL BE FORMED BY A ONE–HALF 1/2) INCH THICK PERFORMED JOINT FILLER, EXTENDING THE FULL DEPTH OF THE SLAB, AND SECURED SO THAT THEY ARE NOT MOVED BY DEPOSITING AND COMPACTING THE CONCRETE AT THESE JOINTS.
4. ISOLATION JOINTS SHALL BE PLACED WHERE SIDEWALK ABUTS OTHER STRUCTURES AND SHALL NOT BE SPACED MORE THAN 50 FEET APART ON STRAIGHT RUNS FOR HANS LAID SIDEWALK AND NOT MORE THAN 100 FEET APART ON STRAIGHT RUNS FOR MACHINE LAID SIDEWALKS.

NOTE:

FOR W 76 COUNTRY BLVD SIDEWALK, CONTRACTOR WILL CONTACT CITY OF BRANSON PUBLIC WORKS/ENGINEERING AT 417–337–8570 FOR CONCRETE SIDEWALK STAMP AND DYE COLOR. DESERT TAN SLATE ROLLER PROVIDED BY THE CITY OF BRANSON.

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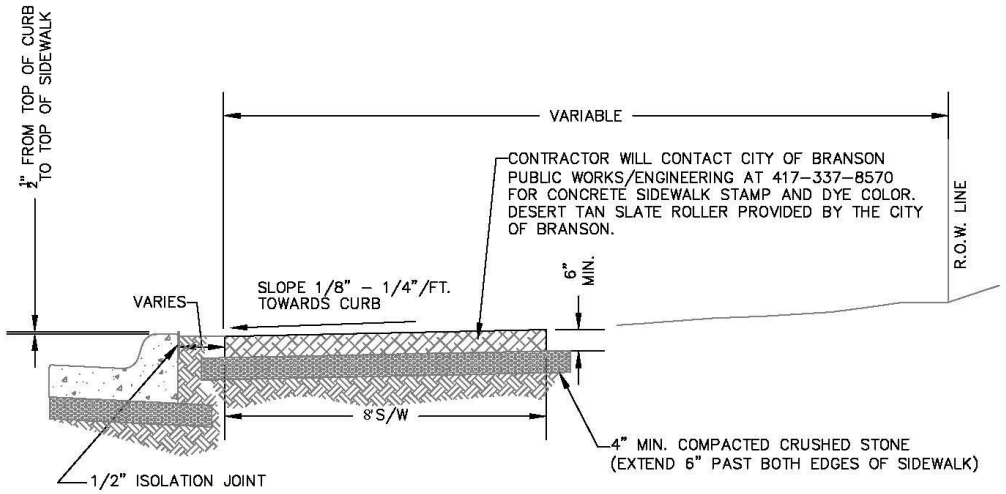
| Branson MISSOURI ★ Engineering & Public Works | 8' CONCRETE SIDEWALK DETAIL | STANDARD DRAWING 22-2 |
| | | ADOPTED 2023 / REVISION |

NOTES:
1. JOINTS SHALL BE FORMED AT RIGHT ANGLES TO THE ALIGNMENT OF THE SIDEWALK AND TO THE DEPTHS INDICATED BELOW.
2. THE SIDEWALK SHALL BE MARKED OFF INTO SQUARE STONES BY CONTRACTION JOINTS. CONTRACTION JOINTS SHALL BE ONE–EIGHT (1/8) INCH WIDE BY ONE (1) INCH DEEP AND SHALL BE FORMED BY TOOLING.
3. ISOLATION JOINTS SHALL BE FORMED BY A ONE–HALF 1/2) INCH THICK PERFORMED JOINT FILLER, EXTENDING THE FULL DEPTH OF THE SLAB, AND SECURED SO THAT THEY ARE NOT MOVED BY DEPOSITING AND COMPACTING THE CONCRETE AT THESE JOINTS.
4. ISOLATION JOINTS SHALL BE PLACED WHERE SIDEWALK ABUTS OTHER STRUCTURES AND SHALL NOT BE SPACED MORE THAN 50 FEET APART ON STRAIGHT RUNS FOR HANS LAID SIDEWALK AND NOT MORE THAN 100 FEET APART ON STRAIGHT RUNS FOR MACHINE LAID SIDEWALKS.

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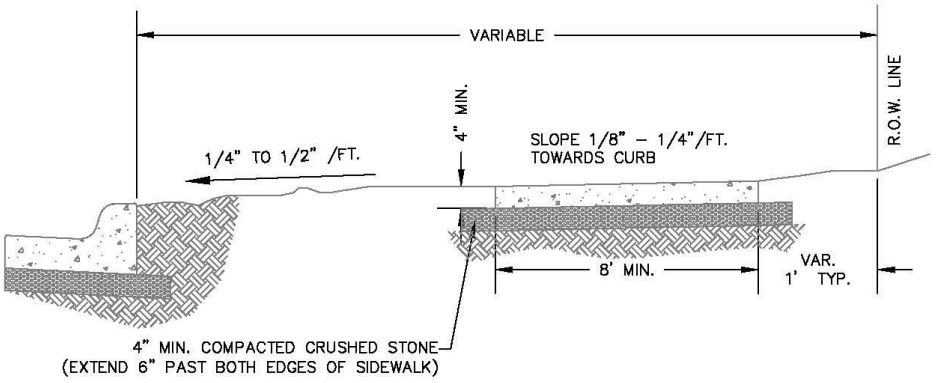
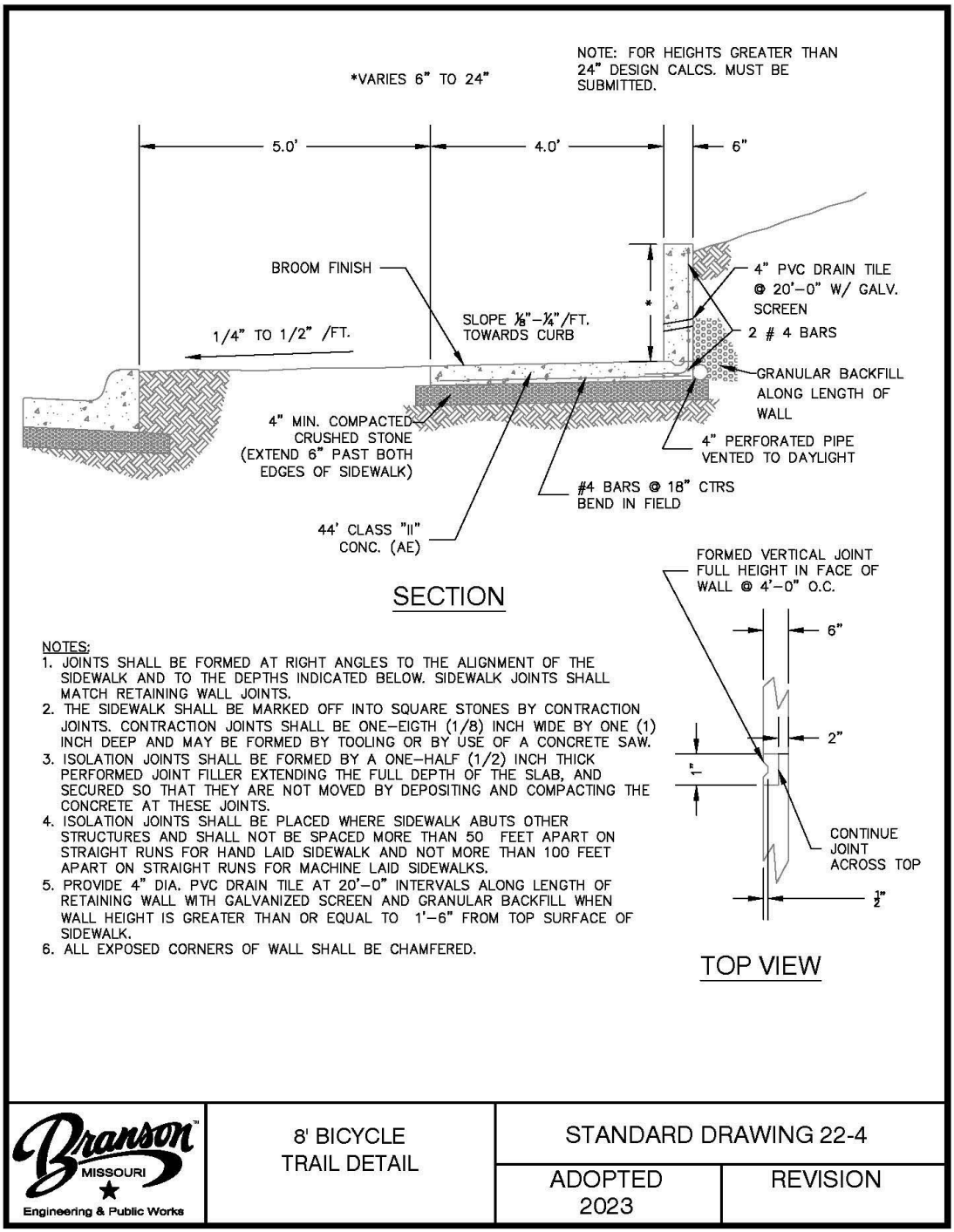
| Branson MISSOURI ★ Engineering & Public Works | W 76 COUNTRY BLVD 8' CONCRETE SIDEWALK DETAIL | STANDARD DRAWING 22-2A |
| | | ADOPTED 2023 / REVISION |

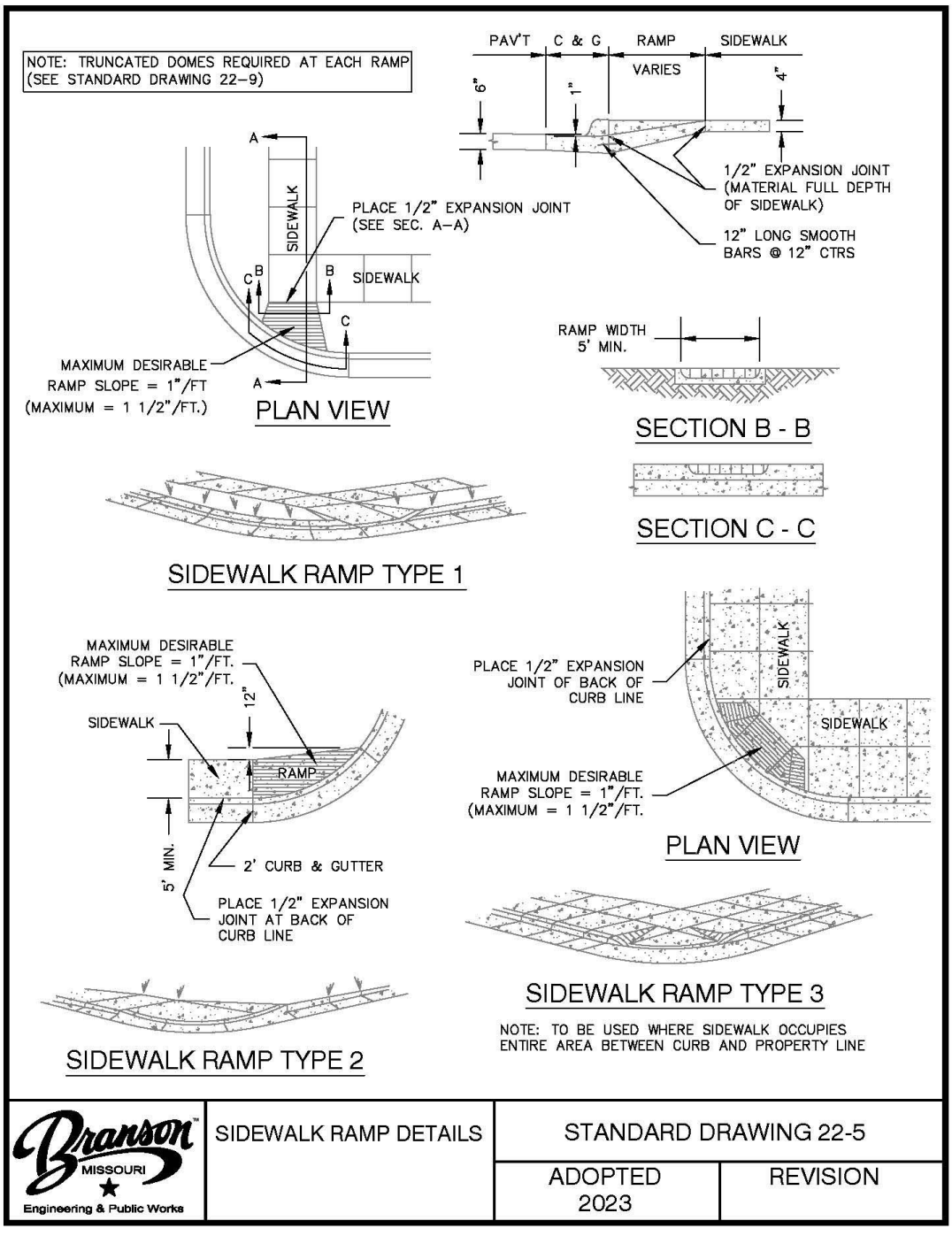
NOTES:

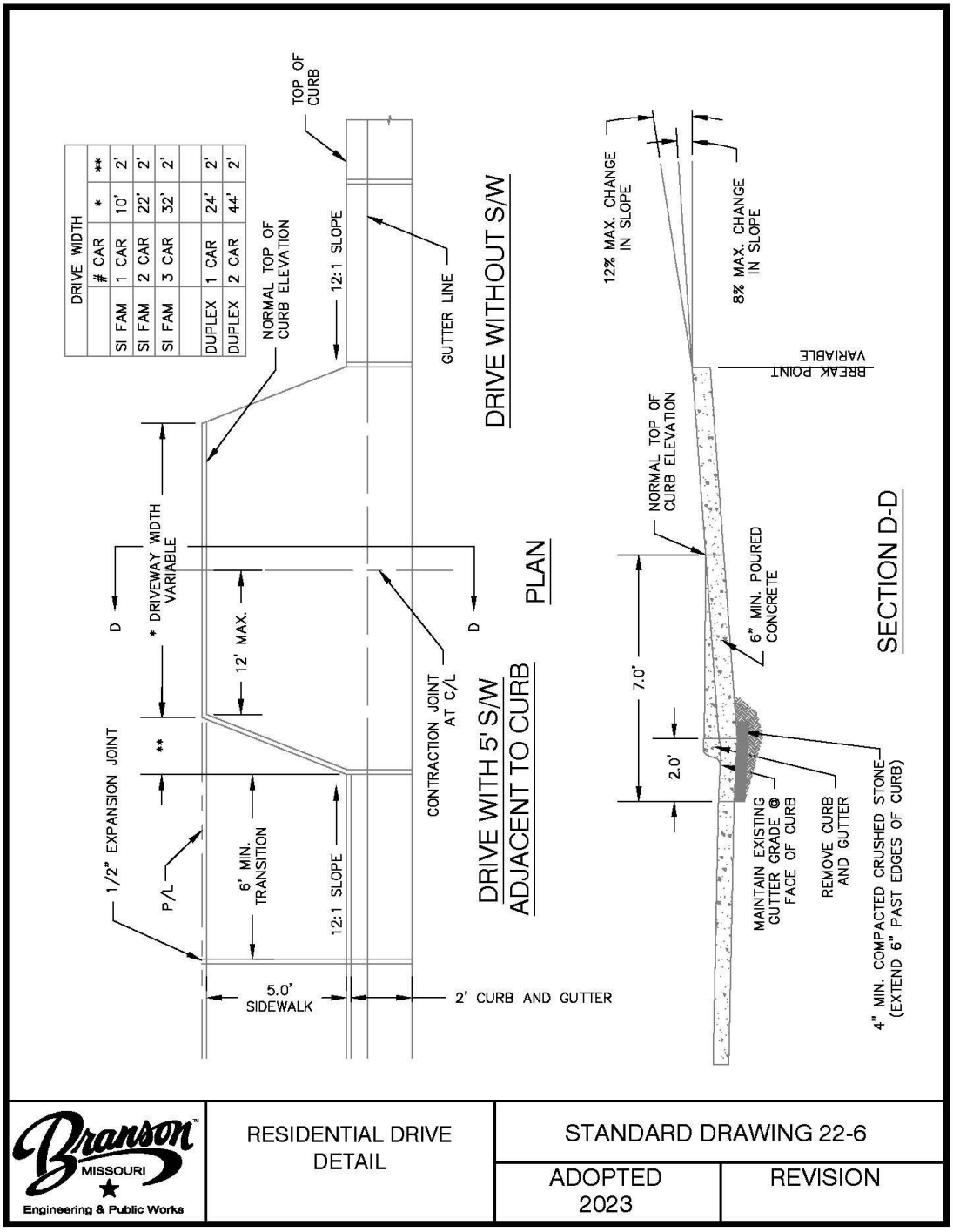
1. JOINTS SHALL BE FORMED AT RIGHT ANGLES TO THE ALIGNMENT OF THE SIDEWALK AND TO THE DEPTHS INDICATED BELOW.
2. THE SIDEWALK SHALL BE MARKED OFF INTO SQUARE STONES BY CONTRACTION JOINTS. CONTRACTION JOINTS SHALL BE ONE–EIGHT (1/8) INCH WIDE BY ONE (1) INCH DEEP AND SHALL BE FORMED BY TOOLING.
3. ISOLATION JOINTS SHALL BE FORMED BY A ONE–HALF 1/2) INCH THICK PERFORMED JOINT FILLER, EXTENDING THE FULL DEPTH OF THE SLAB, AND SECURED SO THAT THEY ARE NOT MOVED BY DEPOSITING AND COMPACTING THE CONCRETE AT THESE JOINTS.
4. ISOLATION JOINTS SHALL BE PLACED WHERE SIDEWALK ABUTS OTHER STRUCTURES AND SHALL NOT BE SPACED MORE THAN 50 FEET APART ON STRAIGHT RUNS FOR HANS LAID SIDEWALK AND NOT MORE THAN 100 FEET APART ON STRAIGHT RUNS FOR MACHINE LAID SIDEWALKS.
5. CONCRETE SHALL BE USED FOR THE CONSTRUCTION OF THE BICYCLE TRAILS LOCATED WITHIN CITY STREET R–O–W AT THE DISCRETION OF THE CITY ENGINEER. A 4" THICK ASPHALT SIDEWALK 8 FEET WIDE ON A 4" THICK AB–3 BASE MAY BE CONSTRUCTED ON CITY R–O–W NOT ADJACENT TO A STREET.

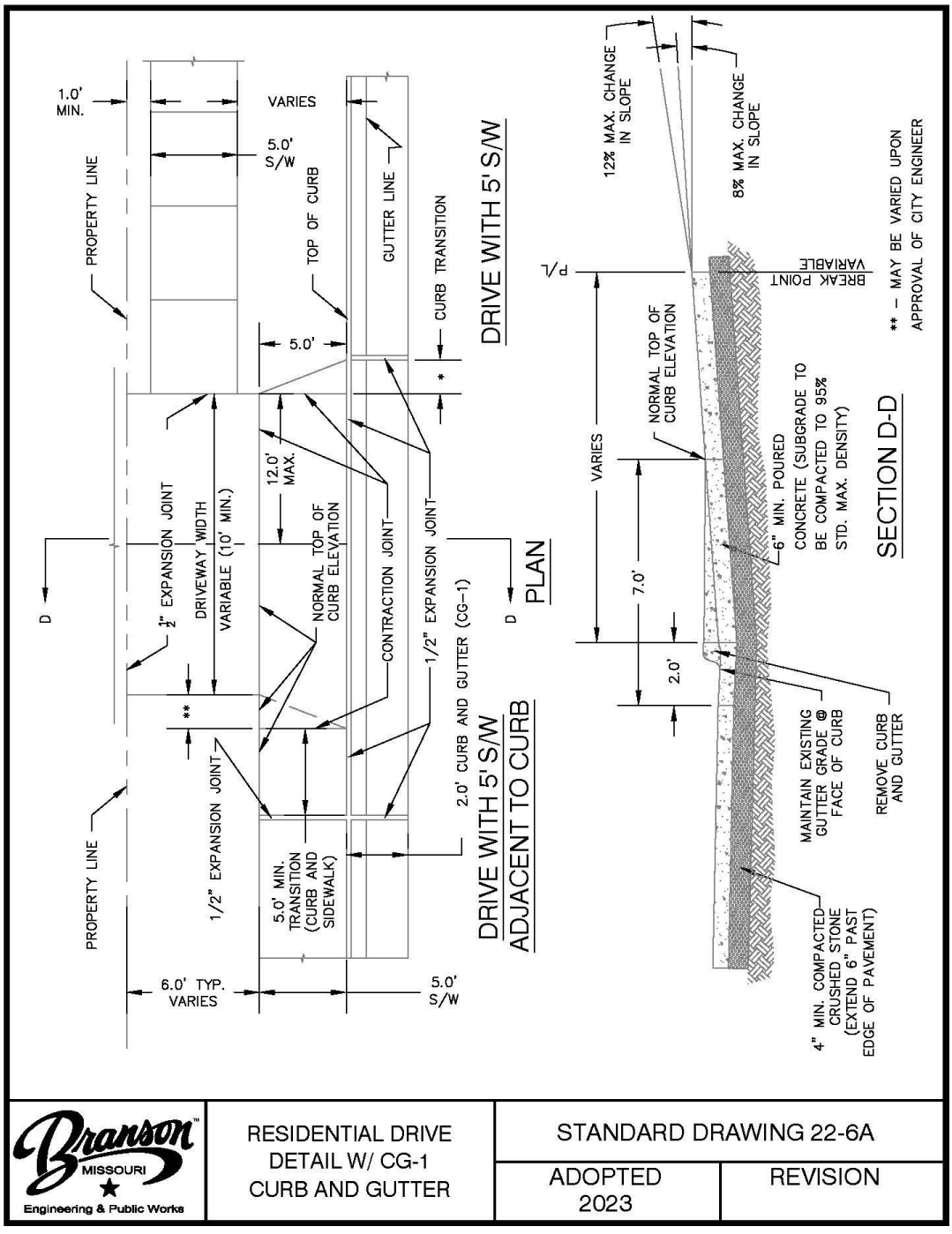


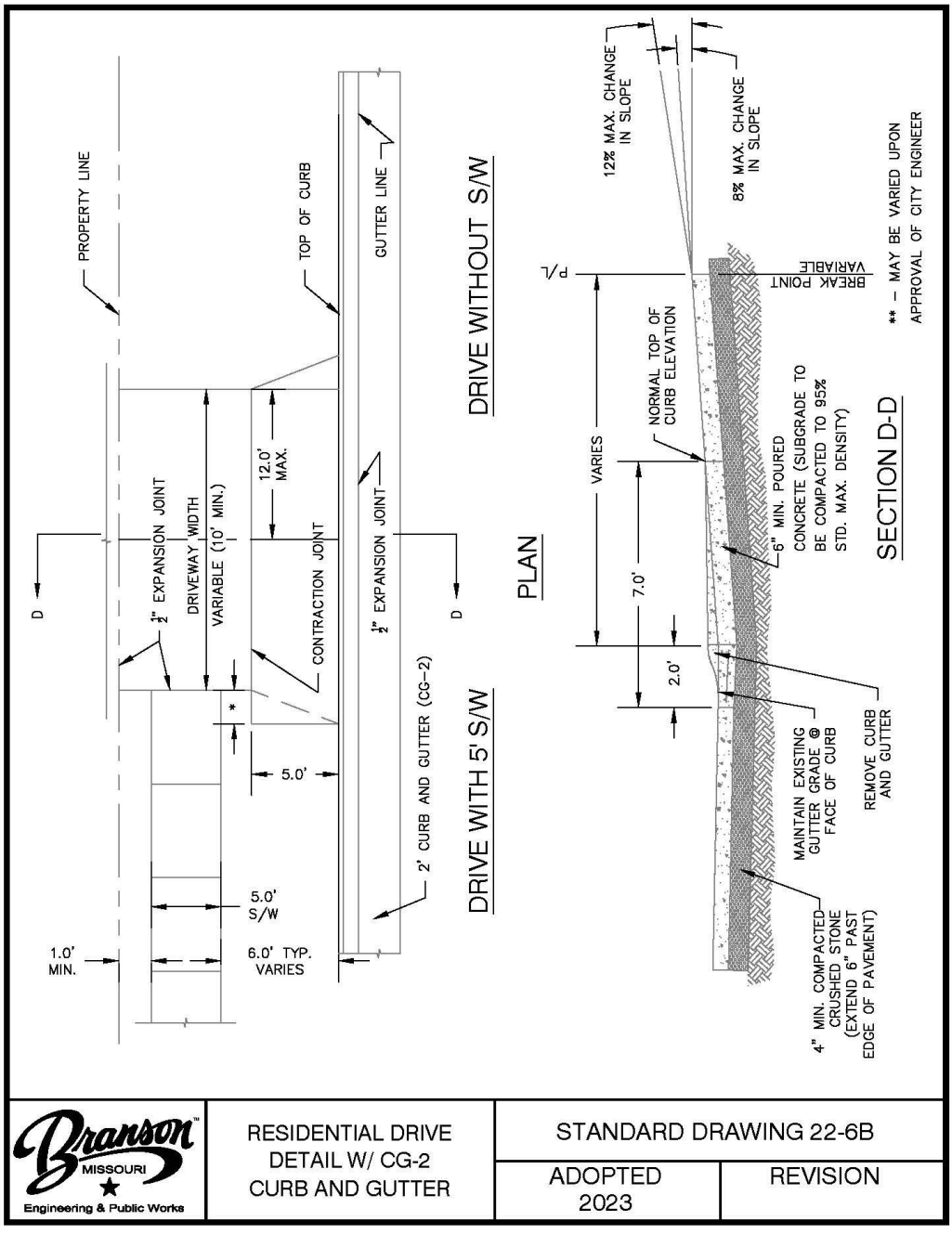

| | | |
|---|---|---|
| Branson MISSOURI ★ Engineering & Public Works | 8' BICYCLE TRAIL DETAIL | STANDARD DRAWING 22-3 |
| | | ADOPTED 2023 / REVISION |

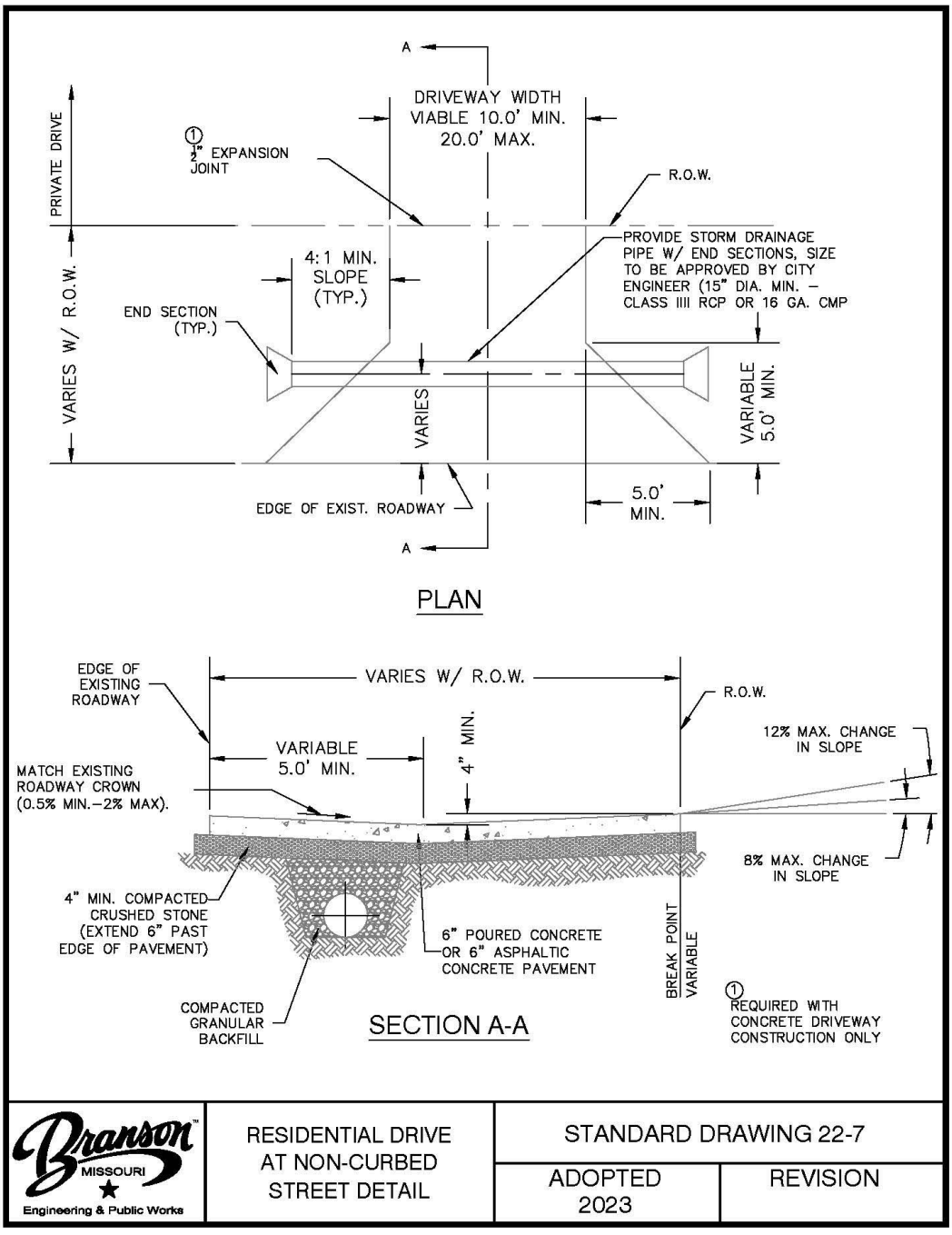

*VARIES 6" TO 24"
NOTE: FOR HEIGHTS GREATER THAN 24" DESIGN CALCS. MUST BE SUBMITTED.
5.0'
4.0'
6"
BROOM FINISH
1/4" TO 1/2" /FT.
SLOPE ⅛"–¼"/FT. TOWARDS CURB
*
4" PVC DRAIN TILE @ 20'–0" W/ GALV. SCREEN
2 # 4 BARS
GRANULAR BACKFILL ALONG LENGTH OF WALL
4" MIN. COMPACTED CRUSHED STONE (EXTEND 6" PAST BOTH EDGES OF SIDEWALK)
4" PERFORATED PIPE VENTED TO DAYLIGHT
#4 BARS @ 18" CTRS BEND IN FIELD
44' CLASS "II" CONC. (AE)
SECTION
FORMED VERTICAL JOINT FULL HEIGHT IN FACE OF WALL @ 4'–0" O.C.
6"
2"
1"
CONTINUE JOINT ACROSS TOP
½"
TOP VIEW
NOTES:
1. JOINTS SHALL BE FORMED AT RIGHT ANGLES TO THE ALIGNMENT OF THE SIDEWALK AND TO THE DEPTHS INDICATED BELOW. SIDEWALK JOINTS SHALL MATCH RETAINING WALL JOINTS.
2. THE SIDEWALK SHALL BE MARKED OFF INTO SQUARE STONES BY CONTRACTION JOINTS. CONTRACTION JOINTS SHALL BE ONE–EIGTH (1/8) INCH WIDE BY ONE (1) INCH DEEP AND MAY BE FORMED BY TOOLING OR BY USE OF A CONCRETE SAW.
3. ISOLATION JOINTS SHALL BE FORMED BY A ONE–HALF (1/2) INCH THICK PERFORMED JOINT FILLER EXTENDING THE FULL DEPTH OF THE SLAB, AND SECURED SO THAT THEY ARE NOT MOVED BY DEPOSITING AND COMPACTING THE CONCRETE AT THESE JOINTS.
4. ISOLATION JOINTS SHALL BE PLACED WHERE SIDEWALK ABUTS OTHER STRUCTURES AND SHALL NOT BE SPACED MORE THAN 50 FEET APART ON STRAIGHT RUNS FOR HAND LAID SIDEWALK AND NOT MORE THAN 100 FEET APART ON STRAIGHT RUNS FOR MACHINE LAID SIDEWALKS.
5. PROVIDE 4" DIA. PVC DRAIN TILE AT 20'–0" INTERVALS ALONG LENGTH OF RETAINING WALL WITH GALVANIZED SCREEN AND GRANULAR BACKFILL WHEN WALL HEIGHT IS GREATER THAN OR EQUAL TO 1'–6" FROM TOP SURFACE OF SIDEWALK.
6. ALL EXPOSED CORNERS OF WALL SHALL BE CHAMFERED.
Branson MISSOURI
Engineering & Public Works
8' BICYCLE TRAIL DETAIL
STANDARD DRAWING 22-4
ADOPTED 2023
REVISION

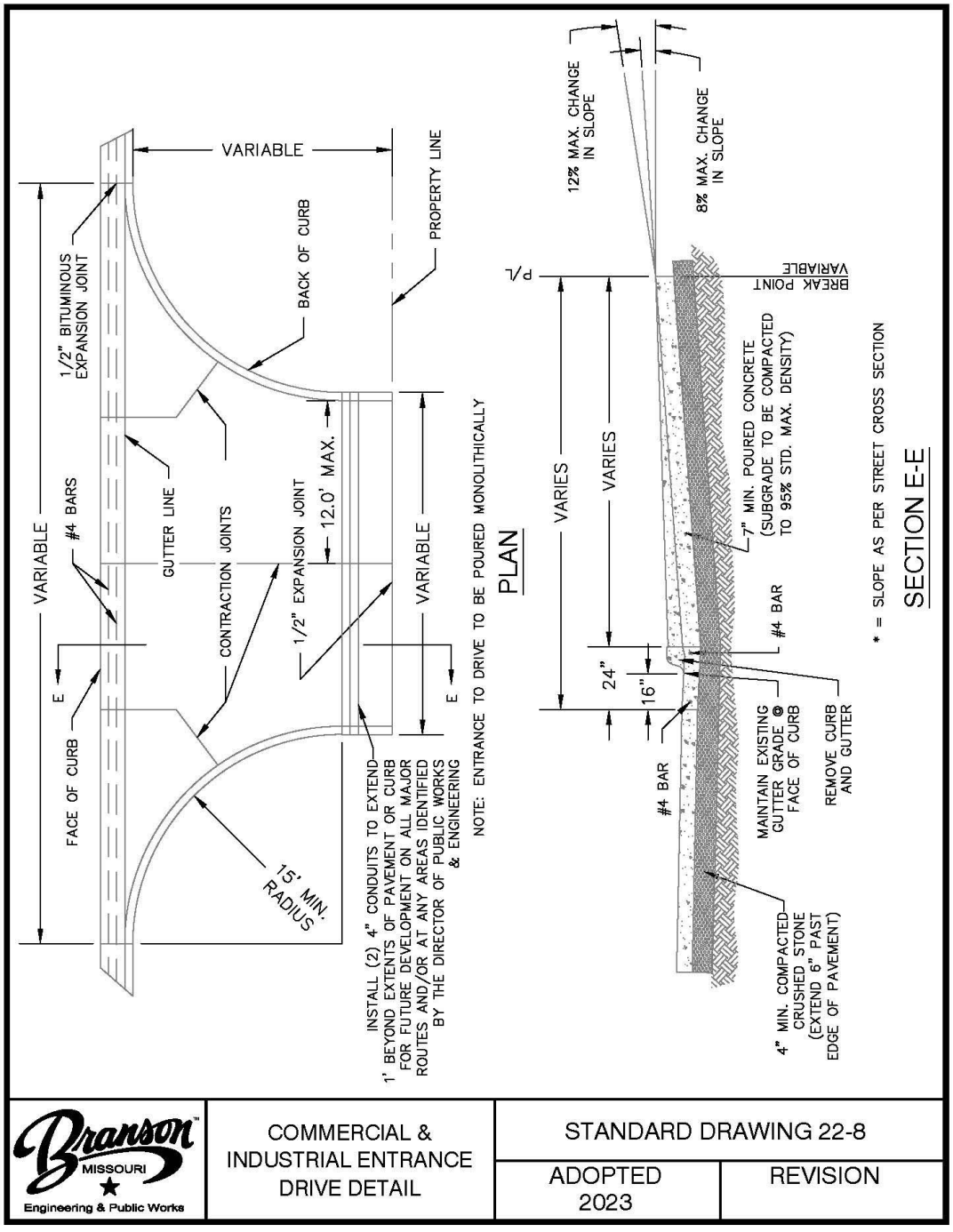

NOTE: TRUNCATED DOMES REQUIRED AT EACH RAMP (SEE STANDARD DRAWING 22-9)
PAV'T
C & G
RAMP
VARIES
SIDEWALK
6"
1"
4"
1/2" EXPANSION JOINT (MATERIAL FULL DEPTH OF SIDEWALK)
12" LONG SMOOTH BARS @ 12" CTRS
A
SIDEWALK
PLACE 1/2" EXPANSION JOINT (SEE SEC. A-A)
B
C
SIDEWALK
MAXIMUM DESIRABLE RAMP SLOPE = 1"/FT (MAXIMUM = 1 1/2"/FT.)
PLAN VIEW
RAMP WIDTH 5' MIN.
SECTION B - B
SECTION C - C
SIDEWALK RAMP TYPE 1
MAXIMUM DESIRABLE RAMP SLOPE = 1"/FT. (MAXIMUM = 1 1/2"/FT.
12"
SIDEWALK
RAMP
5' MIN.
2' CURB & GUTTER
PLACE 1/2" EXPANSION JOINT AT BACK OF CURB LINE
SIDEWALK RAMP TYPE 2
PLACE 1/2" EXPANSION JOINT OF BACK OF CURB LINE
SIDEWALK
SIDEWALK
MAXIMUM DESIRABLE RAMP SLOPE = 1"/FT. (MAXIMUM = 1 1/2"/FT.
PLAN VIEW
SIDEWALK RAMP TYPE 3
NOTE: TO BE USED WHERE SIDEWALK OCCUPIES ENTIRE AREA BETWEEN CURB AND PROPERTY LINE
Branson MISSOURI
Engineering & Public Works
SIDEWALK RAMP DETAILS
STANDARD DRAWING 22-5
ADOPTED 2023
REVISION

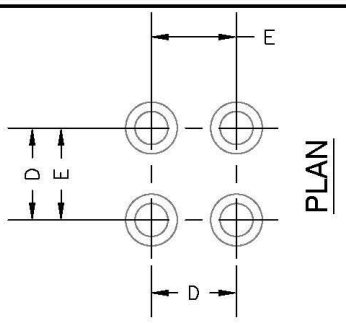

DRIVE WIDTH
# CAR
*
**
SI FAM 1 CAR 10' 2'
SI FAM 2 CAR 22' 2'
SI FAM 3 CAR 32' 2'
DUPLEX 1 CAR 24' 2'
DUPLEX 2 CAR 44' 2'
TOP OF CURB
NORMAL TOP OF CURB ELEVATION
12:1 SLOPE
GUTTER LINE
DRIVE WITHOUT S/W
D
* DRIVEWAY WIDTH VARIABLE
12' MAX.
D
**
1/2" EXPANSION JOINT
P/L
6' MIN. TRANSITION
12:1 SLOPE
CONTRACTION JOINT AT C/L
DRIVE WITH 5' S/W ADJACENT TO CURB
PLAN
5.0' SIDEWALK
2' CURB AND GUTTER
12% MAX. CHANGE IN SLOPE
8% MAX. CHANGE IN SLOPE
BREAK POINT VARIABLE
NORMAL TOP OF CURB ELEVATION
6" MIN. POURED CONCRETE
7.0'
2.0'
MAINTAIN EXISTING GUTTER GRADE @ FACE OF CURB
REMOVE CURB AND GUTTER
4" MIN. COMPACTED CRUSHED STONE (EXTEND 6" PAST EDGES OF CURB)
SECTION D-D
Branson MISSOURI
Engineering & Public Works
RESIDENTIAL DRIVE DETAIL
STANDARD DRAWING 22-6
ADOPTED 2023
REVISION


1.0' MIN.
VARIES
5.0' S/W
PROPERTY LINE
TOP OF CURB
GUTTER LINE
CURB TRANSITION
DRIVE WITH 5' S/W
5.0'
*
12.0' MAX.
1" EXPANSION JOINT
DRIVEWAY WIDTH VARIABLE (10' MIN.)
NORMAL TOP OF CURB ELEVATION
CONTRACTION JOINT
1/2" EXPANSION JOINT
D
PLAN
**
1/2" EXPANSION JOINT
2.0' CURB AND GUTTER (CG-1)
PROPERTY LINE
5.0' MIN. TRANSITION (CURB AND SIDEWALK)
6.0' TYP. VARIES
5.0' S/W
DRIVE WITH 5' S/W ADJACENT TO CURB
12% MAX. CHANGE IN SLOPE
8% MAX. CHANGE IN SLOPE
P/L
BREAK POINT VARIABLE
NORMAL TOP OF CURB ELEVATION
VARIES
7.0'
2.0'
6" MIN. POURED CONCRETE (SUBGRADE TO BE COMPACTED TO 95% STD. MAX. DENSITY)
MAINTAIN EXISTING GUTTER GRADE @ FACE OF CURB
REMOVE CURB AND GUTTER
4" MIN. COMPACTED CRUSHED STONE (EXTEND 6" PAST EDGE OF PAVEMENT)
SECTION D-D
** - MAY BE VARIED UPON APPROVAL OF CITY ENGINEER
Branson MISSOURI
Engineering & Public Works
RESIDENTIAL DRIVE DETAIL W/ CG-1 CURB AND GUTTER
STANDARD DRAWING 22-6A
ADOPTED 2023
REVISION


PROPERTY LINE
TOP OF CURB
GUTTER LINE
½" EXPANSION JOINT
DRIVEWAY WIDTH
VARIABLE (10' MIN.)
12.0' MAX.
CONTRACTION JOINT
½" EXPANSION JOINT
D
D
*
5.0'
2' CURB AND GUTTER (CG-2)
5.0' S/W
1.0' MIN.
6.0' TYP. VARIES
DRIVE WITH 5' S/W
PLAN
DRIVE WITHOUT S/W
12% MAX. CHANGE IN SLOPE
8% MAX. CHANGE IN SLOPE
P/L
BREAK POINT
VARIABLE
** - MAY BE VARIED UPON APPROVAL OF CITY ENGINEER
VARIES
NORMAL TOP OF CURB ELEVATION
7.0'
2.0'
6" MIN. POURED CONCRETE (SUBGRADE TO BE COMPACTED TO 95% STD. MAX. DENSITY)
SECTION D-D
MAINTAIN EXISTING GUTTER GRADE @ FACE OF CURB
REMOVE CURB AND GUTTER
4" MIN. COMPACTED CRUSHED STONE (EXTEND 6" PAST EDGE OF PAVEMENT)
Branson MISSOURI
Engineering & Public Works
RESIDENTIAL DRIVE DETAIL W/ CG-2 CURB AND GUTTER
STANDARD DRAWING 22-6B
ADOPTED 2023
REVISION

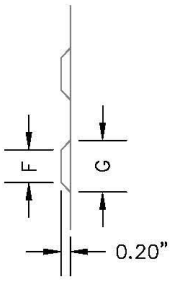

A
DRIVEWAY WIDTH
VIABLE 10.0' MIN.
20.0' MAX.
PRIVATE DRIVE
1
1" EXPANSION JOINT
R.O.W.
PROVIDE STORM DRAINAGE PIPE W/ END SECTIONS, SIZE TO BE APPROVED BY CITY ENGINEER (15" DIA. MIN. – CLASS IIII RCP OR 16 GA. CMP
4:1 MIN. SLOPE (TYP.)
END SECTION (TYP.)
VARIES W/ R.O.W.
VARIES
VARIABLE 5.0' MIN.
EDGE OF EXIST. ROADWAY
5.0' MIN.
A
PLAN
EDGE OF EXISTING ROADWAY
VARIES W/ R.O.W.
R.O.W.
VARIABLE 5.0' MIN.
4" MIN.
12% MAX. CHANGE IN SLOPE
MATCH EXISTING ROADWAY CROWN (0.5% MIN.–2% MAX).
8% MAX. CHANGE IN SLOPE
4" MIN. COMPACTED CRUSHED STONE (EXTEND 6" PAST EDGE OF PAVEMENT)
6" POURED CONCRETE OR 6" ASPHALTIC CONCRETE PAVEMENT
BREAK POINT VARIABLE
1
REQUIRED WITH CONCRETE DRIVEWAY CONSTRUCTION ONLY
COMPACTED GRANULAR BACKFILL
SECTION A-A
Branson MISSOURI
Engineering & Public Works
RESIDENTIAL DRIVE AT NON-CURBED STREET DETAIL
STANDARD DRAWING 22-7
ADOPTED 2023
REVISION


VARIABLE
PROPERTY LINE
BACK OF CURB
1/2" BITUMINOUS EXPANSION JOINT
VARIABLE
#4 BARS
GUTTER LINE
CONTRACTION JOINTS
1/2" EXPANSION JOINT
12.0' MAX.
VARIABLE
E
FACE OF CURB
E
15' MIN. RADIUS
INSTALL (2) 4" CONDUITS TO EXTEND 1' BEYOND EXTENTS OF PAVEMENT OR CURB FOR FUTURE DEVELOPMENT ON ALL MAJOR ROUTES AND/OR AT ANY AREAS IDENTIFIED BY THE DIRECTOR OF PUBLIC WORKS & ENGINEERING
NOTE: ENTRANCE TO DRIVE TO BE POURED MONOLITHICALLY
PLAN
12% MAX. CHANGE IN SLOPE
8% MAX. CHANGE IN SLOPE
P/L
BREAK POINT VARIABLE
VARIES
VARIES
7" MIN. POURED CONCRETE (SUBGRADE TO BE COMPACTED TO 95% STD. MAX. DENSITY)
#4 BAR
24"
16"
#4 BAR
MAINTAIN EXISTING GUTTER GRADE @ FACE OF CURB
REMOVE CURB AND GUTTER
4" MIN. COMPACTED CRUSHED STONE (EXTEND 6" PAST EDGE OF PAVEMENT)
* = SLOPE AS PER STREET CROSS SECTION
SECTION E-E
Branson MISSOURI
Engineering & Public Works
COMMERCIAL & INDUSTRIAL ENTRANCE DRIVE DETAIL
STANDARD DRAWING 22-8
ADOPTED 2023
REVISION

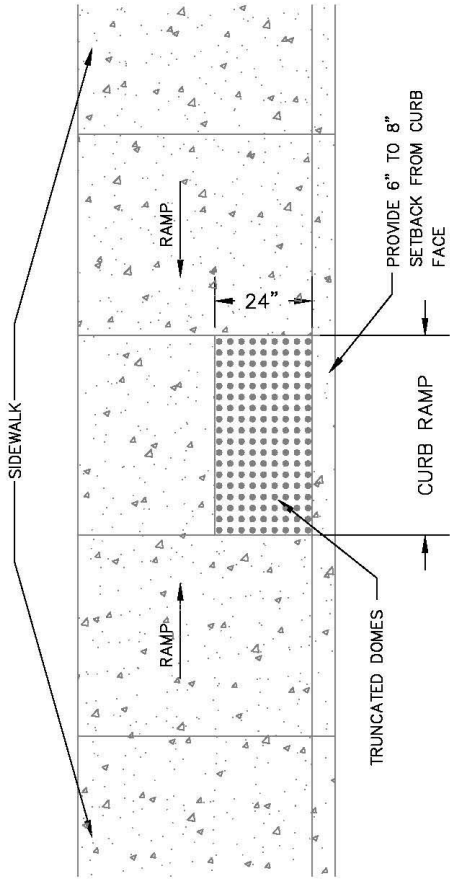



PLAN

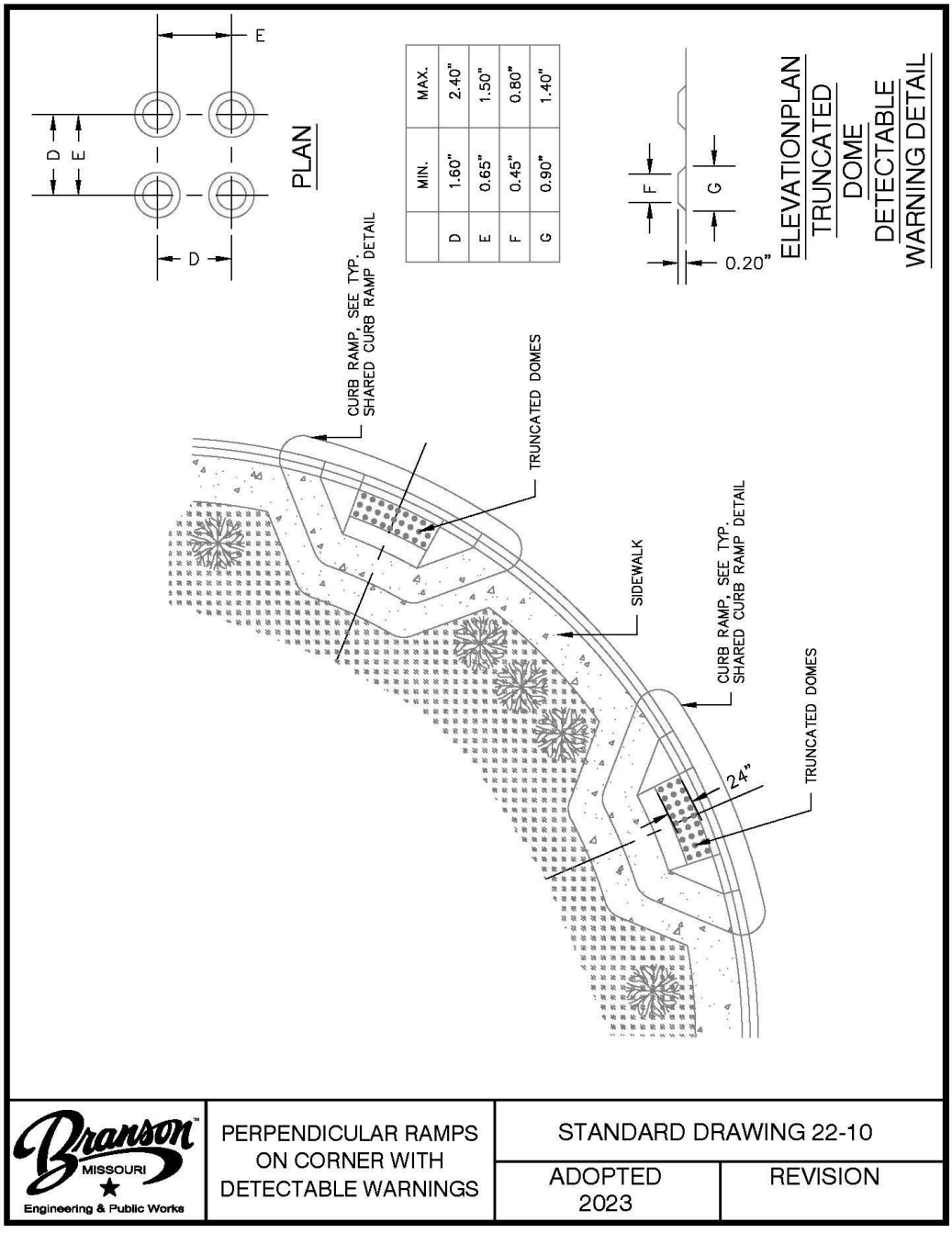
| | MIN. | MAX. |
|---|---|---|
| D | 1.60" | 2.40" |
| E | 0.65" | 1.50" |
| F | 0.45" | 0.80" |
| G | 0.90" | 1.40" |

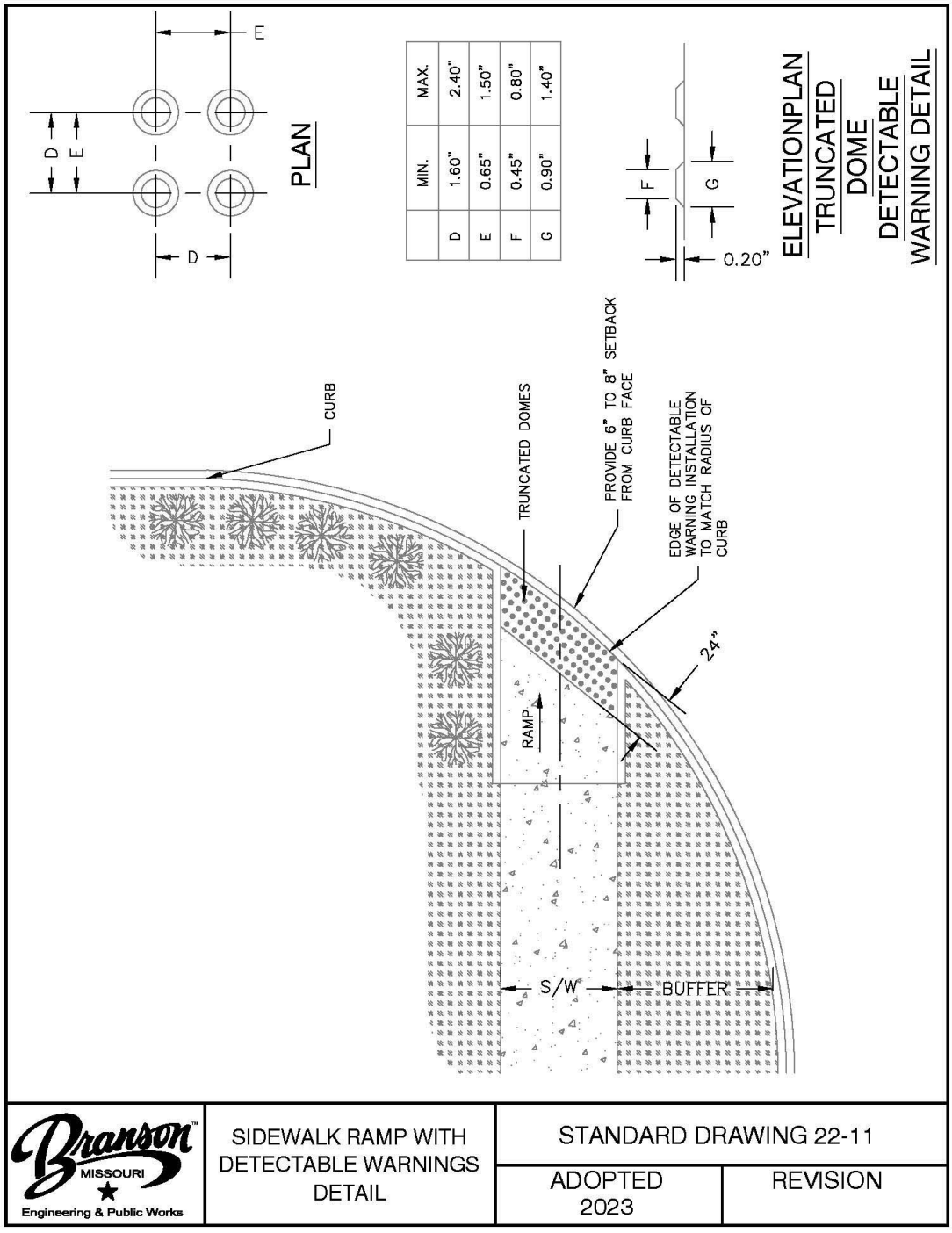


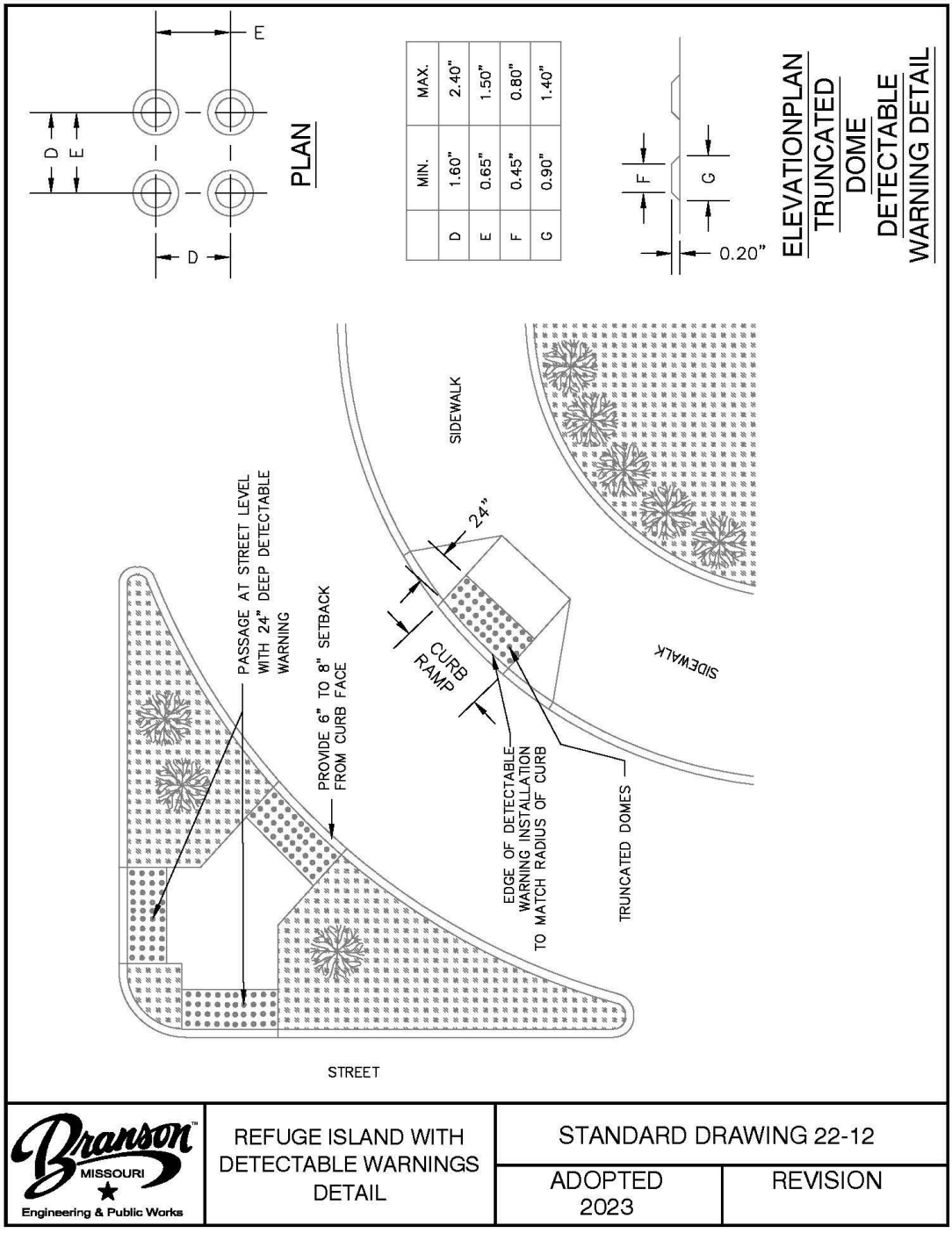

ELEVATIONPLAN
TRUNCATED DOME
DETECTABLE
WARNING DETAIL

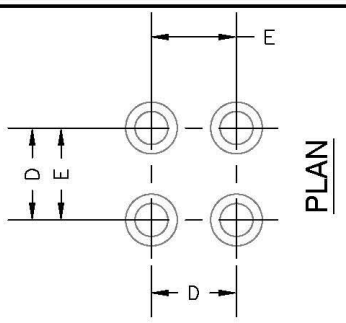



| | | |
|---|---|---|
| Branson MISSOURI ★ Engineering & Public Works | TRANSITION RAMP WITH DETECTABLE WARNING DETAIL | STANDARD DRAWING 22-9 |
| | | ADOPTED 2023 / REVISION |


PLAN
D
E
E
D
CURB RAMP, SEE TYP. SHARED CURB RAMP DETAIL
TRUNCATED DOMES
SIDEWALK
CURB RAMP, SEE TYP. SHARED CURB RAMP DETAIL
TRUNCATED DOMES
24"
ELEVATIONPLAN
TRUNCATED DOME DETECTABLE WARNING DETAIL
F
G
0.20"
MIN. MAX.
D 1.60" 2.40"
E 0.65" 1.50"
F 0.45" 0.80"
G 0.90" 1.40"
Branson MISSOURI
Engineering & Public Works
PERPENDICULAR RAMPS ON CORNER WITH DETECTABLE WARNINGS
STANDARD DRAWING 22-10
ADOPTED 2023
REVISION

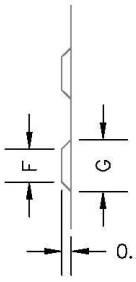

E
D
E
D
PLAN
MIN.
MAX.
D 1.60" 2.40"
E 0.65" 1.50"
F 0.45" 0.80"
G 0.90" 1.40"
F
G
0.20"
ELEVATIONPLAN
TRUNCATED DOME DETECTABLE WARNING DETAIL
CURB
TRUNCATED DOMES
PROVIDE 6" TO 8" SETBACK FROM CURB FACE
EDGE OF DETECTABLE WARNING INSTALLATION TO MATCH RADIUS OF CURB
24"
RAMP
S/W
BUFFER
Branson MISSOURI
Engineering & Public Works
SIDEWALK RAMP WITH DETECTABLE WARNINGS DETAIL
STANDARD DRAWING 22-11
ADOPTED 2023
REVISION


E
D
E
D
PLAN
MIN.
MAX.
D
1.60"
2.40"
E
0.65"
1.50"
F
0.45"
0.80"
G
0.90"
1.40"
F
G
0.20"
ELEVATIONPLAN
TRUNCATED
DOME
DETECTABLE
WARNING DETAIL
SIDEWALK
24"
CURB
RAMP
SIDEWALK
PASSAGE AT STREET LEVEL
WITH 24" DEEP DETECTABLE
WARNING
PROVIDE 6" TO 8" SETBACK
FROM CURB FACE
EDGE OF DETECTABLE
WARNING INSTALLATION
TO MATCH RADIUS OF CURB
TRUNCATED DOMES
STREET
Branson
MISSOURI
Engineering & Public Works
REFUGE ISLAND WITH
DETECTABLE WARNINGS
DETAIL
STANDARD DRAWING 22-12
ADOPTED
2023
REVISION

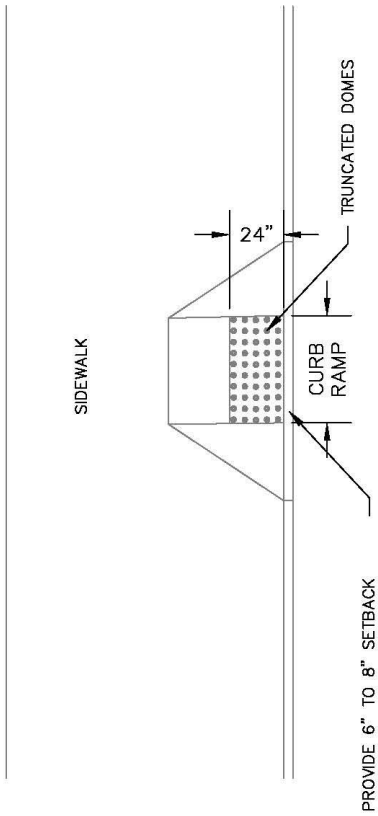



PLAN

| | MIN. | MAX. |
|---|---|---|
| D | 1.60" | 2.40" |
| E | 0.65" | 1.50" |
| F | 0.45" | 0.80" |
| G | 0.90" | 1.40" |




ELEVATIONPLAN
TRUNCATED DOME DETECTABLE WARNING DETAIL



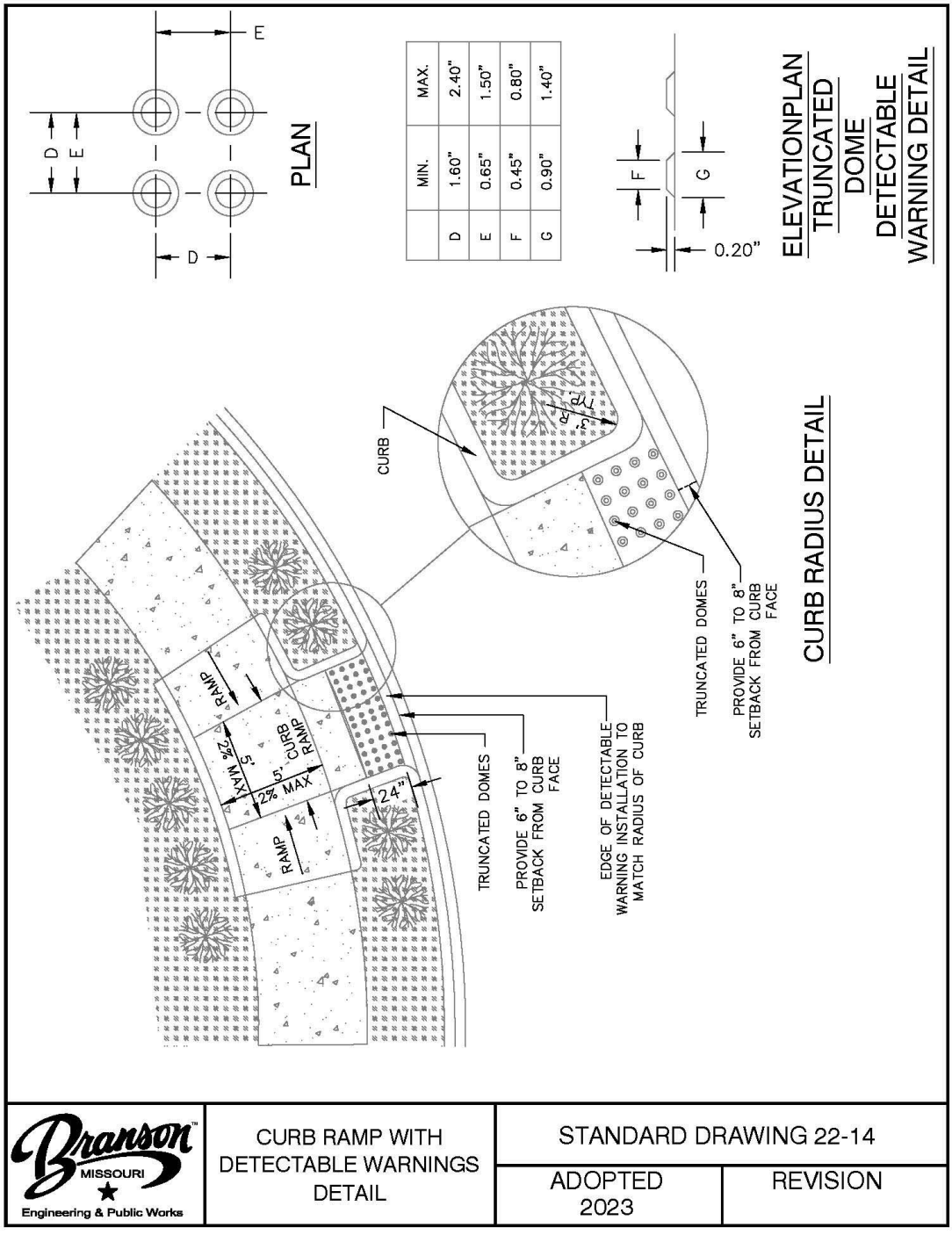

Branson MISSOURI
Engineering & Public Works

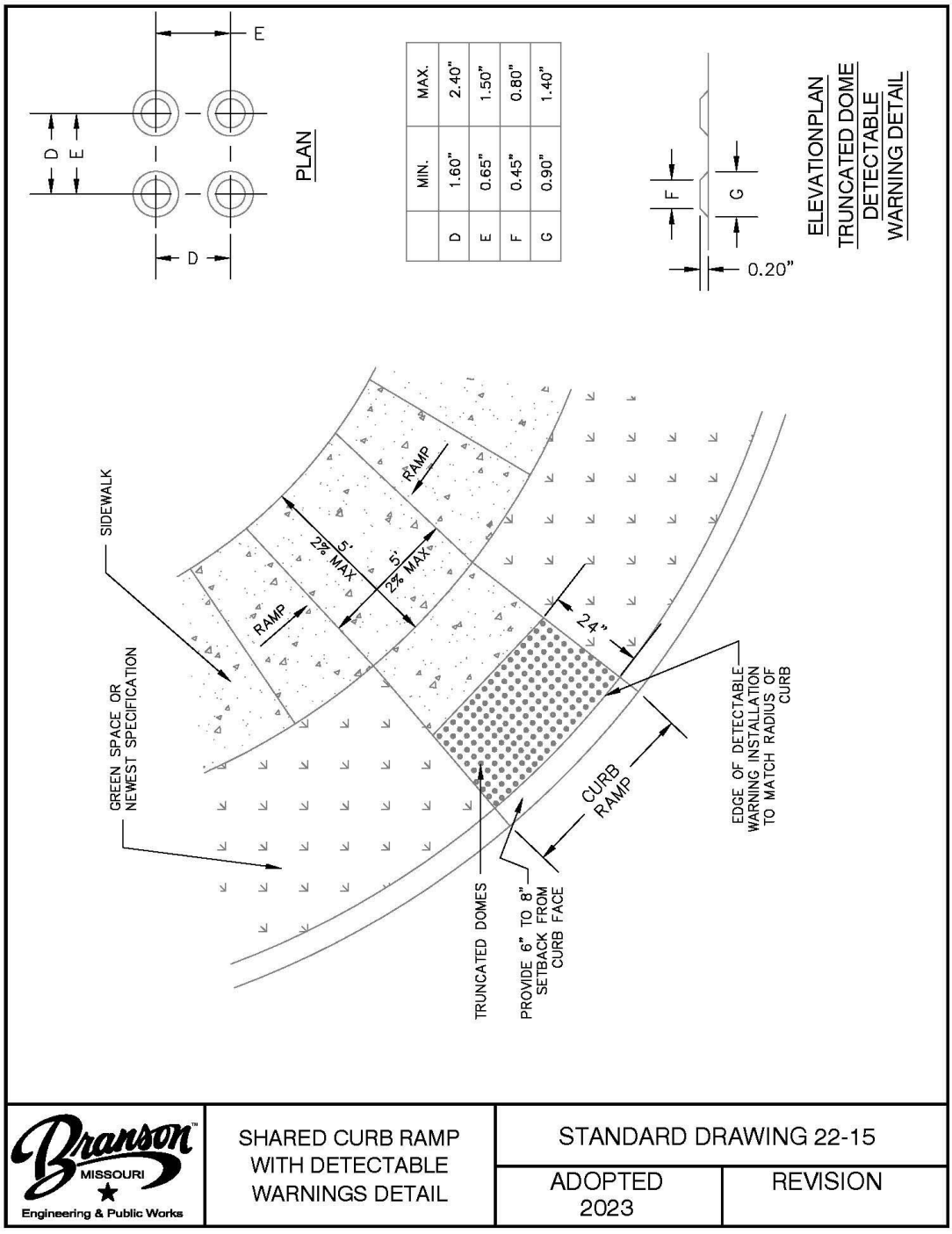
DETECTABLE WARNING AT CURB RAMP DETAIL

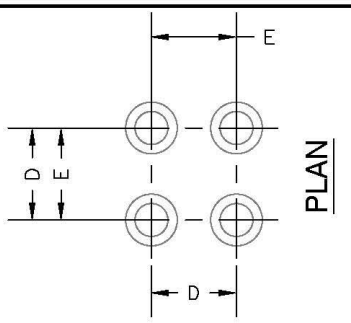
STANDARD DRAWING 22-13

ADOPTED 2023

REVISION

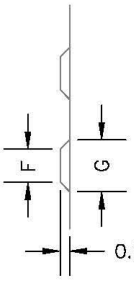

PLAN
D
E
E
D
MIN. MAX.
D 1.60" 2.40"
E 0.65" 1.50"
F 0.45" 0.80"
G 0.90" 1.40"
F
G
0.20"
ELEVATIONPLAN
TRUNCATED DOME
DETECTABLE WARNING DETAIL
CURB RADIUS DETAIL
CURB
TRUNCATED DOMES
PROVIDE 6" TO 8" SETBACK FROM CURB FACE
RAMP
2% MAX
5' CURB RAMP
2% MAX
5'
RAMP
24"
TRUNCATED DOMES
PROVIDE 6" TO 8" SETBACK FROM CURB FACE
EDGE OF DETECTABLE WARNING INSTALLATION TO MATCH RADIUS OF CURB
Branson MISSOURI
Engineering & Public Works
CURB RAMP WITH DETECTABLE WARNINGS DETAIL
STANDARD DRAWING 22-14
ADOPTED 2023
REVISION


E
D
E
D
PLAN
MIN.
MAX.
D 1.60" 2.40"
E 0.65" 1.50"
F 0.45" 0.80"
G 0.90" 1.40"
F
G
0.20"
ELEVATIONPLAN
TRUNCATED DOME
DETECTABLE
WARNING DETAIL
SIDEWALK
GREEN SPACE OR
NEWEST SPECIFICATION
RAMP
5'
2% MAX
5'
2% MAX
RAMP
24"
CURB
RAMP
EDGE OF DETECTABLE
WARNING INSTALLATION
TO MATCH RADIUS OF
CURB
TRUNCATED DOMES
PROVIDE 6" TO 8"
SETBACK FROM
CURB FACE
Branson
MISSOURI
Engineering & Public Works
SHARED CURB RAMP
WITH DETECTABLE
WARNINGS DETAIL
STANDARD DRAWING 22-15
ADOPTED
2023
REVISION

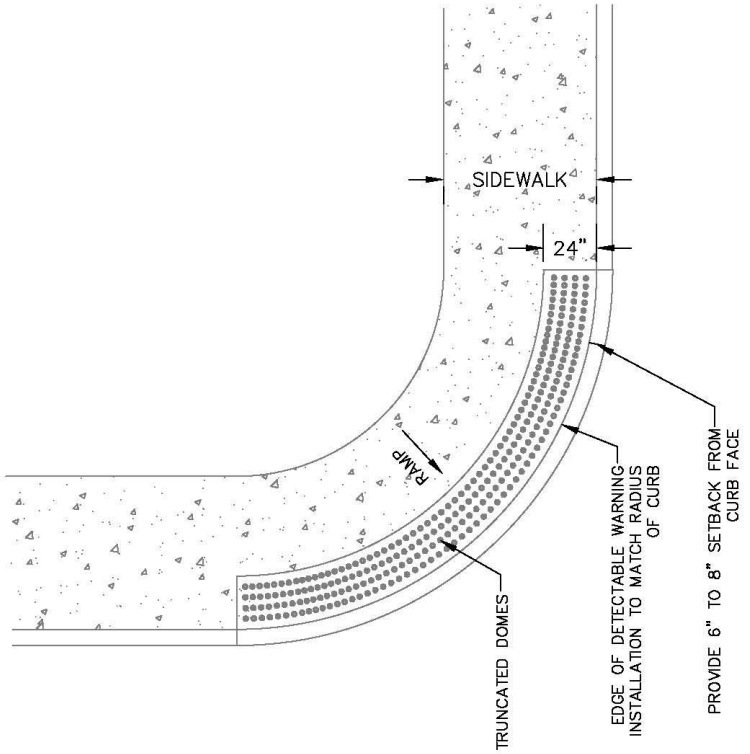



PLAN

| | MIN. | MAX. |
|---|---|---|
| D | 1.60" | 2.40" |
| E | 0.65" | 1.50" |
| F | 0.45" | 0.80" |
| G | 0.90" | 1.40" |




ELEVATIONPLAN
TRUNCATED DOME DETECTABLE WARNING DETAIL

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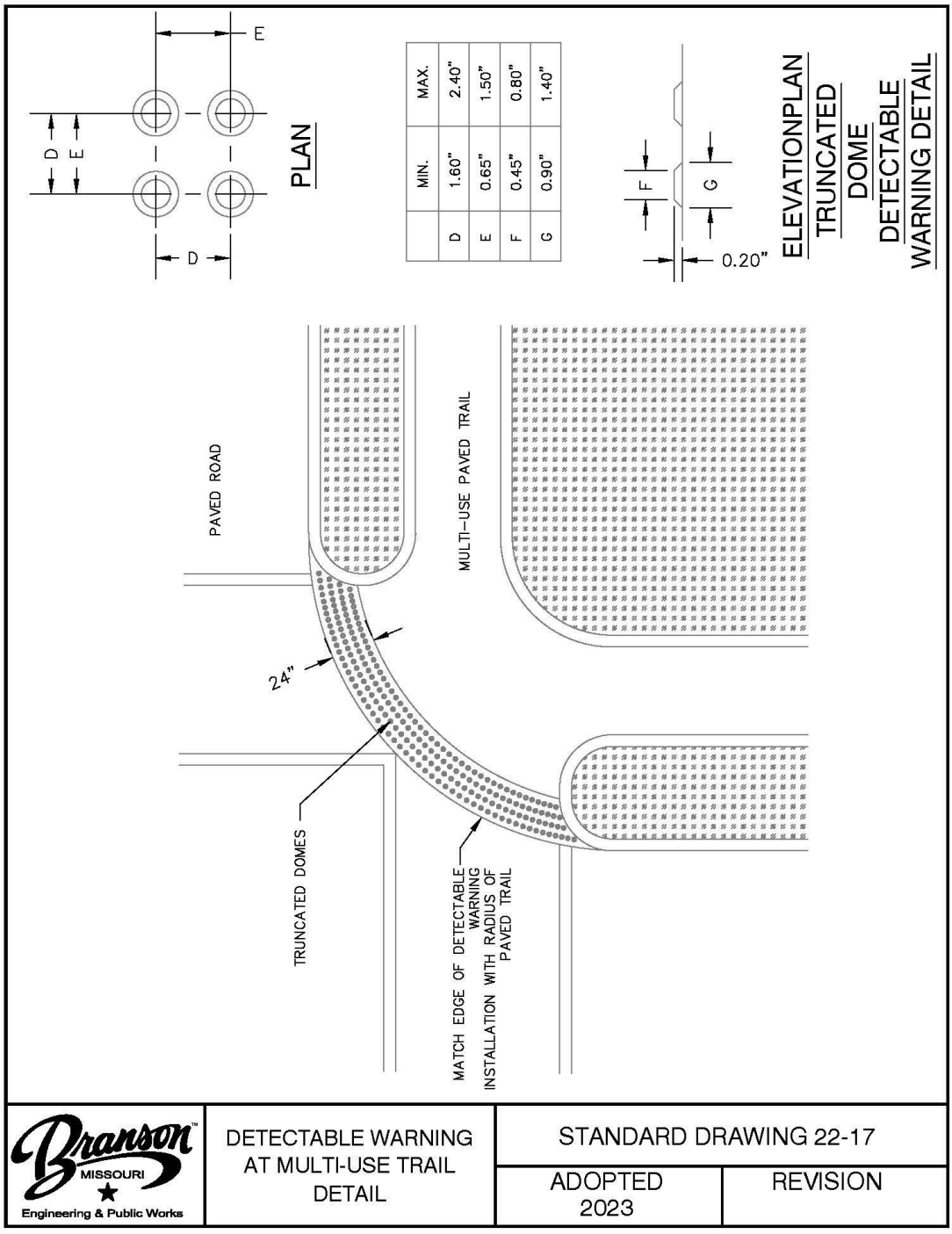
| Branson MISSOURI Engineering & Public Works | DETECTABLE WARNING AT BLENDED CURB DETAIL | STANDARD DRAWING 22-16 |
| | | ADOPTED 2023 / REVISION |


E
D
E
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PLAN
MIN.
MAX.
D 1.60" 2.40"
E 0.65" 1.50"
F 0.45" 0.80"
G 0.90" 1.40"
F
G
0.20"
ELEVATIONPLAN
TRUNCATED DOME DETECTABLE WARNING DETAIL
PAVED ROAD
MULTI-USE PAVED TRAIL
24"
TRUNCATED DOMES
MATCH EDGE OF DETECTABLE WARNING INSTALLATION WITH RADIUS OF PAVED TRAIL
Branson MISSOURI
Engineering & Public Works
DETECTABLE WARNING AT MULTI-USE TRAIL DETAIL
STANDARD DRAWING 22-17
ADOPTED 2023
REVISION

SECTION 2300 STEEL BEAM GUARDRAIL

2301 SCOPE. This section governs the furnishing of all labor, equipment, tools, and materials and the performance of all work necessary for the installation of steel beam guardrail as shown on the construction plans or standard drawings.

2302 MATERIALS.

A. Steel Posts. All posts, terminal posts connectors, and steel blocks for guardrail shall be formed from a structural steel meeting the requirements of ASTM A-36, and shall be galvanized in accordance with ASTM A 123.

B. Guardrail and Hardware. All guardrail and hardware shall conform to the requirements of AASHTO M-180 Class A, Type 1. Hardware shall be galvanized in accordance with ASTM A 153. Guardrail shall be galvanized with a minimum of 1.80 ounces of Zinc per sq. ft. All Zinc shall be “Prime Western” grade or better.

2303. ERECTION.

A. Setting Posts. Posts shall be set to the depth and spaced at the intervals shown on the construction plans or standard drawings. They shall be set vertical and true to line and grade. Steel posts may be driven by a power hammer or may be set in, dug or bored holes of a size sufficient to permit thorough compacting of the backfill around the post. The backfill material shall be dry sand, placed in layers not exceeding 12 inches in thickness to a height 12 inches below the finished grade. After erecting and adjusting the rail to true line and grade, the sand backfill shall be compacted by flooding. The final 12 inches of backfill consisting of suitable earth material shall then be compacted in six inch (6”) lifts. Any "mushrooming" of the top of the post shall be removed and damaged spelter coating on posts shall be repaired by the Zinc alloy stick method while the surface is heated to approximately 600 degrees Fahrenheit. Other methods of repairing the spelter coating shall receive prior approval of the Engineer.

B. Placing Guardrail. Bolt holes shall be shop punched. Field punching, reaming and drilling will not be permitted. Guardrail beams shall be spliced, only at posts by lapping in the direction of traffic, using the required number of splice bolts. Beams for twisted turned down terminal sections may be either field or shop twisted. Sufficient twist shall be introduced such that the beam shall retain the required shape in a relaxed condition. Beams to be erected on a radius of 150 feet or less shall be shop-curved as shown on the plans.

Each end of every installation of guardrail shall have an end, bridge anchor, or terminal section of the design and type shown on the construction plans or standard drawings. They shall be of the same material and shall be galvanized in accordance with the requirements for the guardrail beam.

Galvanized rail shall be handled in a manner to avoid damage to the galvanized coating. Any sections of rail, end sections or terminal sections on which the spelter coating has been bruised or broken shall be rejected, or may, with the prior approval of the Engineer, be repaired by the method described for repairing damaged spelter coating of steel posts.

SECTION 2400 TRAFFIC CONTROL

2401 GENERAL. The Contractor shall be responsible for maintenance, control, and the safeguarding of traffic within and immediately abutting the project as further outlined herein, and as may otherwise be provided for in the Special Provisions. The City will be responsible for maintenance, control, and safeguarding of traffic on all detours which do not lie within the project limits, unless otherwise required in the Special Provisions or contract drawings.

2402 STREET CLOSURES. Streets may not be closed to through traffic unless otherwise provided for in the Special Provisions. Streets shall not be closed to traffic until such closure has been approved by the Engineer. Street closures shall be made in such a manner as to provide for maximum public safety and public convenience, and if closed, shall be opened to through traffic at such time as the work has been completed, or as the Engineer may direct.

2403 EXISTING TRAFFIC SIGNS AND FACILITIES. The City, unless otherwise indicated, will make all necessary adjustments to traffic signals and traffic signal activators at no cost to the Contractor. Existing traffic and street name signs which will interfere with construction shall be removed by the Contractor and stored in a safe place. These signs shall not be removed until the Engineer has so directed and until the necessary measures have been taken to safeguard traffic after the signs have been removed. Preservation and maintenance of the signs shall be the sole responsibility of the Contractor. Upon completion of the project, the Contractor shall reset all such signs.

2404 DETOURS. Detours outside the limits of the project shall be the sole responsibility of the Contractor unless otherwise provided in the Special Provisions. Detours within the limits of the project such as side street crossings, temporary bridges over freshly placed concrete, utilization of one or more lanes of the construction are for maintenance of traffic, and such related facilities for the maintenance of traffic shall be the responsibility of the Contractor, the costs which shall be included in the unit contract prices unless otherwise provided for in the Special Provisions. All detour signage shall conform to the standards set forth in MUTCD.

2405 LOCAL AND EMERGENCY TRAFFIC. Local traffic shall be provided access to private properties at all time, except during some urgent states of construction when it is impracticable to carry on the construction and maintain traffic simultaneously, such as for the placing of pavement and deep excavations which prohibit safe travel of vehicular traffic. No private driveway may be closed without the approval of the Engineer, unless written permission has been given the Contractor by the owner of the property affected.

Emergency traffic such as police, fire and disaster units shall be provided reasonable access at all times. The Contractor shall be liable for any damages which may result from his failure to provide such reasonable access.

2406 PROTECTION OF PEDESTRIAN AND VEHICULAR TRAFFIC. The Contractor shall take every precaution to protect pedestrian and vehicular traffic. Whenever, in the opinion of the Engineer, the Contractor has not provided sufficient or proper safety precautions and safeguards, he shall do so immediately and to whatever extent the Engineer deems advisable.

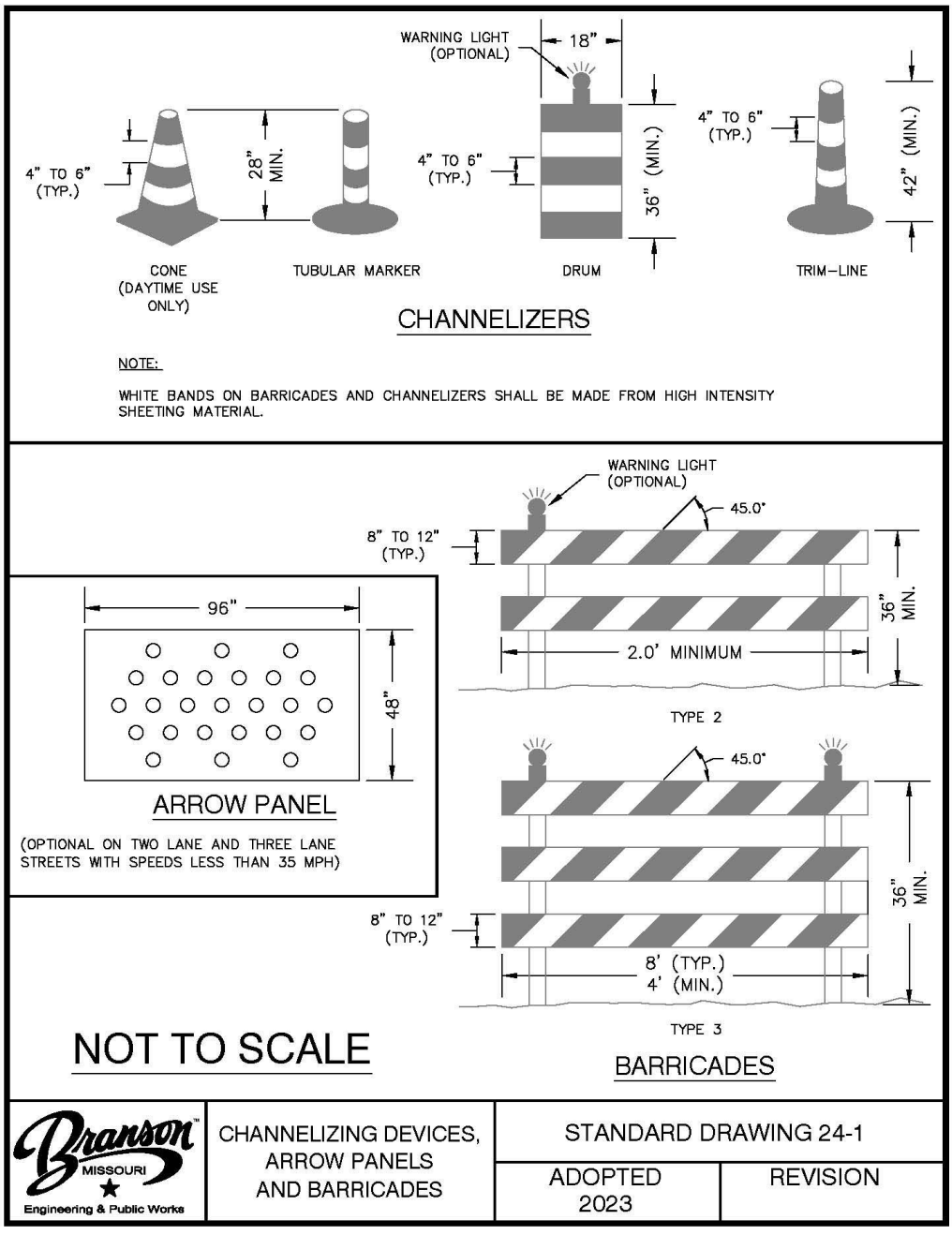
2407 RESTRICTION OF PARKING. Where parking is a hazard to through traffic or to the construction work. It shall be restricted either entirely or during the time when it creates a hazard. Signs for this purpose will be initially furnished and placed by the City unless indicated otherwise. The Contractor shall be responsible for and shall maintain the signs if they are used on any street which is directly involved in the construction work. If the parking signs are to be used beyond the confines of the work area, such as another street being used as a detour, the signs will be the responsibility of the Contractor.

2408 FLAGMEN. The Contractor shall furnish at his own expense all flagmen who may be needed unless otherwise provided for in the Special Provisions.

2409 TRAFFIC CONTROL WITHIN AND ABUTTING THE PROJECT. The contractor shall place and maintain all signs, barricades and warning lights within the limits of the project on all streets, alleys, and driveways entering the project so that approaching traffic will turn right or left on existing and undisturbed streets before reaching the warning signs and barriers immediately abutting the project. Unless otherwise provided for in the Special Provisions, all required signs will be furnished by the Contractor.

Barricades shall be furnished by the Contractor. The barricades shall be of a conventional design normally used in street construction work, and painted a current traffic yellow with black stripes as shown in Part VI of the Manual on Uniform Traffic Control Devices, latest edition.

2410 FLASHERS. Flashers used shall be a type approved by the Engineer with a seven inch (7”) lens, amber in color, and reflectorized rim. The rate of flashes shall be regular and shall be between 50 and 60 flashes per minute +/- 5 percent; the "on" time shall be at least 25 percent of the cycle +/- 5 percent. Batteries shall be replaced in flasher units when the voltage is less than 4.6 volts for a 6-volt unit and 9.2 volts for a 12-volt unit.


WARNING LIGHT
(OPTIONAL)
18"
4" TO 6"
(TYP.)
28"
MIN.
4" TO 6"
(TYP.)
36" (MIN.)
4" TO 6"
(TYP.)
42" (MIN.)
CONE
(DAYTIME USE
ONLY)
TUBULAR MARKER
DRUM
TRIM-LINE
CHANNELIZERS
NOTE:
WHITE BANDS ON BARRICADES AND CHANNELIZERS SHALL BE MADE FROM HIGH INTENSITY SHEETING MATERIAL.
96"
48"
ARROW PANEL
(OPTIONAL ON TWO LANE AND THREE LANE STREETS WITH SPEEDS LESS THAN 35 MPH)
WARNING LIGHT
(OPTIONAL)
45.0°
8" TO 12"
(TYP.)
36"
MIN.
2.0' MINIMUM
TYPE 2
45.0°
8" TO 12"
(TYP.)
36"
MIN.
8' (TYP.)
4' (MIN.)
TYPE 3
NOT TO SCALE
BARRICADES
Branson
MISSOURI
Engineering & Public Works
CHANNELIZING DEVICES,
ARROW PANELS
AND BARRICADES
STANDARD DRAWING 24-1
ADOPTED
2023
REVISION

SECTION 2500 COLD MILLING

2501 SCOPE. This section governs the furnishing of all labor, materials and equipment for the performance of cold milling pavement surfaces as shown on the Plans and in accordance with the Standard Drawings, the specifications and the Special Provisions. This work will consist of the removal of the existing surface, loading, hauling, and stockpiling, if required, of the milled material and the cleaning of the milled surface.

2502 EQUIPMENT. Milling the surface of pavements shall be completed by the use of a milling machine conforming to the following:

A. Machine: The cold milling machine shall be self-propelled and able to automatically control grade and slope of the milled surface. Operate the automatic grade and slope control from a travelling string line a minimum of 30 feet long, attached the milling machine and operating parallel to the direction of travel. Other methods of positive grade control may be used if approved by the Engineer. The machine shall have the means of milling without damaging the remaining pavement (torn, gouged, shoved, broken, etc.). The machine shall be capable of blading the cuttings into a single windrow or depositing them directly into a truck.

B. Air Pollution: The machine shall be equipped with a dust suppression system including water storage tanks and high pressure spray bars.

C. Operating Width: It is desirable that the cutting width be greater than 6 feet. In the event the cutting width is less than 6 feet, a system of electronic grade control for consecutive passes will be required

D. Cutting Drum: The cutting drum shall be totally enclosed to prevent discharge of any loosened material on adjacent work areas.

2503 CONSTRUCTION DETAILS

A Methods of operations for Milling:

1. Utilities. Street surfaces adjacent to manholes, water valves and other utility extensions, shall be completely removed to the full depth of cut specified for the street unless otherwise specified by the Engineer.

2. Material Disposal. All material from the milling operation shall be removed immediately from the surface of the pavement and properly disposed of by the Contractor at an approved disposal area.

3. Surface Conditions: The drum lacing patterns shall produce a smooth surface finish after milling, with groove depths not to exceed 1/4 inch and groove spacing not to exceed 1 inch unless otherwise approved by the Engineer.

B. Types of Cuts to be made by Milling:

1. Leveling. Sufficient passes, shall be made such that all irregularities or high spots are eliminated, and that 100 percent of the surface is milled.

2. Average Depth. Sufficient passes, or cuts, shall be made in order to remove a specified depth over the entire street section. These depths will be designated in the Plans or Special Provisions or as directed by the Engineer.

3. Curb Cut: Sufficient passes or cuts shall be made to remove the specified depth at the curb for a specified width. These dimensions will be designated in the Plans or Special Provisions.

4. Bridge Deck Planning. Sufficient passes, or cuts, shall be made in order to remove the material as specified on the plans or in the Special Provisions.

C. Clean-up: All loose asphalt and debris shall be removed from the street surface and curb and gutter. Any material and debris that adheres to the curb and gutter shall be removed.

D. Opening to Traffic: If the milled area will be opened to traffic prior to surfacing, provide a smooth riding surface by either milling or placing a wedge of hot mix asphalt or other approved material of a thickness and design that will remain in place under traffic. The transition between the milled area and transverse joints shall be a minimum of 1 vertical to 24 horizontals. The transition between milled surface and manholes, utility fixtures or other appurtenances shall be a minimum of 1 vertical to 12 horizontals. Transitions shall be removed prior to surfacing.

2504 METHOD OF MEASUREMENT. Cold milling will be measured per square yard daily and rounded to the tenth at the completion of the project.

2505 BASIS OF PAYMENT. Cold Milling will be paid for by one of the following:

A. Contract unit bid price.

B. Contract lump sum bid price.

# SECTION 2600 PAVEMENT CRACK SEALING, PAVEMENT CRACK FILLING, STREET CHIP SEAL AND STREET SLURRY SEAL

2601 SCOPE. This section governs the furnishing of all labor, equipment, tools and material, and the performance of all work necessary for asphalt crack sealing, asphalt crack filling, chip sealing, slurry sealing and micro-surfacing, complete, in place, at the locations specified in the Special Provisions and as directed by the Director of Public Works/Engineering.

The following standards are referenced directly in this section. The latest version of these standards shall be used. If conflicting standards are referenced, the more stringent standard shall apply.

ASTM

C 88 Test Method for Soundness of Aggregates by Use of Sodium Sulfate or Magnesium Sulfate
C 117 Test Method for Materials Finer than 75- um (No. 200) Sieve in Mineral Aggregates by Washing
C 131 Test Method for Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine
C 136 Test Method for Sieve Analysis of Fine and Coarse Aggregates
C 142 Test Method for Clay Lumps and Friable Particles in Aggregates
D 36 Standard Test Method for Softening Point of Bitumen (Ring-and-Ball Apparatus)
D 140 Practice for Sampling Bituminous Materials
D 242 Standard Specification for Mineral Filler For Bituminous Paving Mixtures
D 244 Standard Test Methods for Emulsified Asphalts
D 946 Standard Specification for Penetration-Graded Asphalt Cement for Use in Pavement Construction
D 977 Standard Specification for Emulsified Asphalt
D 1073 Standard Specification for Fine Aggregate for Bituminous Paving Mixtures
D 2027 Standard Specification for Cutback Asphalt (Medium-Curing Type)
D 2028 Standard Specification for Cutback Asphalt (Rapid-Curing Type)
D 2397 Standard Specification for Cationic Emulsified Asphalt
D 2419 Standard Test Method for Sand Equivalent Value of Soils and Fine Aggregate
D 3381 Standard Specification for Viscosity-Graded Asphalt Cement for Use in Pavement Construction
D 3910 Standard Practices for Design, Testing, and Construction of Slurry Seal
D 5078 Standard Specification for Crack Filler, Hot-Applied, for Asphalt Concrete and Portland Cement Concrete Pavements
D 6372 Standard Practice for Design, Testing, and Construction of Micro-Surfacing
D 6690 Standard Specification for Joint and Crack Sealants, Hot Applied, for Concrete and Asphalt Pavements

AASHTO

T 53 Softening Point of Bitumen (Ring-and-Ball Apparatus)
T 59 Testing Emulsified Asphalts
M 208 Standard Specification for Cationic Emulsified Asphalt

ISSA Bulletin #139 “Test Method to Classify Emulsified Asphalt/Aggregate Mixture Systems by Modified Cohesion Tester Measurement of Set and Cure Characteristics”

Manual of Uniform Traffic Control Devices, latest Edition (MUTCD)

## 2602 CRACK SEALING/FILLING

Crack Sealing Application: Material used for crack sealing shall be a modified asphalt product selected to be compatible with the environment of application and found to meet the criteria of ASTM D 6690 with a modified resilience value between 30 and 60 percent, or material meeting the requirements of ASTM D 5078. Crack Sealing shall be understood to be the process of placing an asphaltic material into and/or above working cracks to prevent the intrusion of surface water and/or incompressible into the crack. A working crack shall be understood to correspond to cracks that sustain more than 0.1 inch of movement during the course of the year.

A. When the ambient temperature exceeds 60 degrees Fahrenheit the material used for crack sealing may be emulsified asphalt Designation CRS-1 or CRS-2.

B. Crack Filling Application: Material used for crack filling shall be a viscosity graded AC-20 asphalt product meeting the criteria of ASTM D 3381 Table 1, a penetration-graded asphalt product having a penetration number in the range of 85-100 measured in accordance with ASTM D 946, or material meeting the criteria of ASTM D 5078. Crack filling material may contain polyester or polypropylene fibers.

C. Material satisfying the criteria of a crack sealant may also be used as a crack filling material. Crack filling shall be understood to be the process of placing an asphaltic material into non-working cracks to substantially reduce water infiltration and reinforce adjacent cracks. Crack filling materials shall not be used for sealing pavements in preparation for an overlay.

D. Equipment:

1. Cleaning Router: This machine shall be an impact cutter head with a minimum of 6 tungsten-carbide cutters. The router blades shall be driven with a minimum 25-hp gasoline engine.

2. Compressor: The compressor shall be a two-stage compressor rated as a minimum 40 CFM unit capable of delivering compressed air to the nozzle at a minimum pressure of 100 psi. The compressor shall be equipped with a filter trap to eliminate oil and moisture from the air line.

3. Hot-Air Lance (HCA): The hot air lance shall be capable of delivering super-heated air at an exit temperature in excess of 1500 degrees F and at a velocity in excess of 1000 ft./sec against the side walls of the crack. The hose shall be wrapped with reflective tape to keep hoses together and to protect workers in low light situations.

4. Melter/Applicator:

a. The melting pot shall consist of double-boiler type jacket and shall be equipped with a full sweep agitator that promotes proper mixing and maintains uniform heat distribution throughout the melting pot. The melting

pot shall have sufficient capacity of the heat transfer oil reservoir that heat transfer oil is able to come in contact with 100 percent of the outside area of the jacket. The melting pot shall be equipped with a drain plug to permit 100% of the heat transfer oil to drain from the boiler. The heat transfer oil shall consist of ISO grade 68.

b. The heat transfer oil shall be heated with a properly sized vapor fuel LP or diesel fuel burner. The heat shall be applied directly to the bottom of the heat transfer tank. The burner shall be lit by an electric spark igniter controlled by a sensor, which detects a lack of burn or ignition and subsequently shuts down the fuel supply. The unit must be capable of starting at ambient temperature and bringing the sealant up to the required applications temperature within the period of approximately one hour while continuously agitating and recirculating the sealant. The unit shall have the capability of independently monitoring both the transfer oil and melting pot temperatures. The unit shall be capable of heating a variety of application materials within a range of temperatures between 200 º F and 425 º F. The sealant should not be heated to a temperature in excess of that specified by the manufacturer.

c. The agitator and material pump shall be actuated by hydraulic motors driven by a single, pressure-compensated hydraulic pump. Hydraulic fluid should only be pumped to the agitator or material pump motor on demand.

d. The sealant shall be applied to the pavement through an application system consisting of a pressure feed hose and wand. The hose shall be specially manufactured to handle liquid asphalt products up to 450 º F at 350 psi working pressure. The hose shall not be less than 15 feet in length. The hand wand shall be constructed of steel of sufficient strength to withstand normal day-to-day operations. Material flow through the wand shall be controlled with a toggle switch. A squeegee shall be used to distribute the asphalt evenly and uniformly in the recommended configuration.

e. All equipment shall be in good working order, as determined by the Director of Public Works/Engineering, on a day-to-day basis. The Director of Public Works/Engineering shall not be responsible for payment of labor or rental charges on days when the equipment is not in good working order.

E. <u>Preparation:</u>

1. Crack sealing shall be limited to working, transverse and longitudinal cracks that are more than 1/8- inch in width. Cracks 1/8- to 5/8-inches in width requiring sealing shall be routed to 5/8-inches in width. Cracks 5/8- to 1-inch in width requiring sealing do not require routing but shall be thoroughly cleaned and sealed. Cracks shall be sealed using either the Standard Reservoir and Flush or Standard Recessed Band-Aid configurations. Cracks greater than 1-inch in width shall be filled with either an emulsion slurry and sand, widened and backfilled with Hot-Mix Asphalt (HMA) in compliance with Section 2205, or repaired in a manner approved by the Engineer.

Cracks requiring filling do not require any routing but simply thorough cleaning. Cracks shall be filled using either the Simple Band-Aid, Simple Flush Fill, or Capped configurations.

2. Cracks shall be clean and free of all deleterious materials, including any old sealant, incompressible, and organic material. The crack shall be free of any standing water and any moisture along the sidewalls of the crack as evidenced by a darker color than the adjacent pavement. This shall be accomplished in one of three manners: wire-brushing – where the crack channels are cleaned with a mechanical wire brush followed by high-pressure compressed air; hot air blasting – where the crack channels are cleaned, heated, dried with hot compressed air (HCA) lance connected to a high pressure air compressor; or high-pressure air blasting – where the crack channels are cleaned with high-pressure compressed air. Pavement cracks to be sealed or filled shall be cleaned and dried using one of the methods described previously within 10 minutes of the application of the sealer/filler. Equipment for the two operations should be kept in a compact configuration such that not more than 50 feet separates equipment required by the two operations. Additionally, not more than 10 minutes time can passed between the cleaning of a crack and the filling of the crack with the appropriate sealing/filling material.

F. Filling Procedure. After all cracks have been thoroughly cleaned, the operator of the hand hose shall apply hot liquid asphalt to the cleaned cracks. Application of the liquid asphalt shall be done in such a manner to avoid an accumulation of excess material on areas adjacent to the cracks. Excess material on the cracked areas shall be redistributed by means of a U-shaped squeegee.

## 2603 IMPROVED STREET CHIP SEAL.

A. Description: This work shall consist of the application of a thin, uniform layer of emulsified asphalt to the existing pavement surface in order to universally seal cracks from the intrusion of surface water. Cover aggregate shall then be uniformly distributed upon the asphalt layer and seated in place with the use of a rubber-tired roller. Any excess aggregate material shall be removed, leaving a durable wearing surface.

B. Material Requirements:

1. Emulsified Asphalt:

a. The asphaltic sealant material applied to the roadway surface shall consists of a rapid-setting emulsified asphalt either an anionic RS-2 meeting the criteria of ASTM D 977 or a cationic CRS-2 meeting the criteria of ASTM D 2397. These materials may be modified with rubber products in the form of liquid latex, styrene-butidane-rubber, or styrene-butidane-styrene to enhance performance of the material as approved by the Engineer. If a polymer-modified material is used, the emulsified asphalt shall meet the additional specification criteria required by the Engineer.

b. A sample of the emulsified asphalt may be taken from any of the distributors or delivery tankers on the job site. Failure of the emulsified asphalt to meet the material specification criteria at the time of application shall require the Contractor, at his own expense, to correct all unsatisfactory areas. No additional areas shall be sealed until correction has been made to the satisfaction or the Engineer.

2. Cover Aggregate – Pre-coated Chips

a. Materials: Aggregate materials shall consist of an approximately cubic and uniformly-graded, hard, durable 100 percent crushed and washed limestone, sandstone, lightweight aggregate, basalt/porphyry, granitic material, steel slag, gravel, or chat. Chat is a by-product from the production of lead and zinc from the area located in southwestern Missouri, northeastern Oklahoma, and southeastern Kansas. Lightweight aggregate shall consist of expanded shale. The application rates reported in these specifications is for the Bethany Falls Limestone in the Kansas City area. The specific gravity of this material is approximately 2.58.

b. Physical properties required of the aggregate materials:

Los Angeles Abrasion (ASTM C131) 35% loss (maximum)
Soundness using Mag. Sulfate (ASTM C 88, 5 cycles) 18% loss (maximum)
Soundness using Sodium Sulfate (ASTM C 88, 5 cycles) 12% loss (maximum)
Total Shale, clay, coal, and lignite content (ASTM C 142) 0.5% by weight (max) Absorption 4.0% (max) Los Angeles Abrasion (ASTM C131) 35% loss (maximum)
Soundness using Mag. Sulfate (ASTM C 88, 5 cycles) 18% loss (maximum)
Soundness using Sodium Sulfate (ASTM C 88, 5 cycles) 12% loss (maximum)

Total Shale, clay, coal, and lignite content (ASTM C 142) 0.5% by weight (max) Absorption 4.0% (max) Los Angeles Abrasion (ASTM C131)

c. Gradation: Gradation of cover aggregates shall conform to the following percentages:

| Sieve Size | Percentage Passing |
|---|---|
| 3/4” (19mm) | 100 |
| 1/2” (12.5mm) | 90-95 |
| 3/8” (9.5mm) | 30-50 |
| No. 4 (4.75mm) | 0-5 |
| No. 8 (2.36mm) | 0 |

d. Pre-coating of Chips: Aggregate chips shall be uniformly heated in a dryer until surface dry. All material shall be free of moisture, dust, and lumps and shall be approved by the Engineer prior to use. The aggregate chips shall then

be pre-coated with 0.9%+ 0.025% a liquid asphalt cement having a viscosity of 2000 poise, +20%. The asphaltic material and hot aggregate shall be measured separately and accurately immediately before introduction into the mixer. Mixing shall be accomplished at a temperature between 275 º F and 325 º F, sufficient to produce a thoroughly and uniformly coated aggregate. The pre-coated chips shall be stockpiled at least 3 days prior to use.

3. Weighing: Weighing of cover aggregate shall be accomplished by the Contractor on scales that he furnishes for the purpose of weighing the cover aggregate as required in MoDOT Standard Specifications, Section 310. All loads of cover aggregate will be weighed and evidenced by approved delivery tickets showing the net weight in pounds for each load. Two copies of each ticket shall accompany the load to the work site. Upon the load being incorporated in the work, the Engineer will sign both copies and one of these copies will be returned to the Contractor.

C. Spot Patching: Areas where base failure of the roadway has occurred, or where the surface is broken out shall be repaired prior to the sealing operation. The failed sections will be marked by the Engineer, and shall be removed by sawing a neat rectangular hole into the pavement. The failed material shall be removed without damage to the adjacent pavement. Where base failures have occurred, the pavement shall be removed to the subgrade which shall be corrected to the satisfaction of the Engineer prior to patching. Unstable material shall be over excavated and replaced with base materials meeting the requirements of Section 2203. All surfaces shall be properly primed and tacked in accordance with Section 1300.

The prepared hole shall be patched with hot-mix asphaltic patching material by placing in layers not to exceed 2 inches; each layer being thoroughly compacted before the next layer is placed. After the patching material is placed and raked to a uniform surface, it shall be thoroughly compacted by rolling with a roller meeting the requirements of Section 1400. The edges shall be well bonded with the old surface. The completed patch shall be in the same plane as the existing pavement.

The asphaltic concrete used for patching at the different locations shall be as directed by the Engineer and shall conform to one of the mixes as set out in 1400.

D. Sealing

1. Cleaning: After all holes and cracks have been repaired to the satisfaction of the Engineer, and immediately before sealing the Contractor shall thoroughly clean the area to be sealed with a mechanical pickup type sweeper to insure proper adhesion of the new seal coat to the existing pavement. The street shall be dry before applying the seal coat.

2. Sealing: After the street has been prepared as set forth above the Contractor shall apply the emulsified asphalt by means of an approved distributor meeting the requirements of Section 1300. Provisions shall be made by the Contractor to properly protect the curbs and gutters from the asphaltic spray. Emulsified asphalt shall be applied at a rate between 0.28 and 0.35 gallons per square yard. The specific rate for

each job will be determined by the Engineer in the field.

Immediately after the application of the asphalt, the Contractor shall, by means of a self-propelled mechanical spreader, apply a uniform layer of cover aggregate. This material shall be spread at the rate specified by the Engineer. This rate shall be between 18 and 25 pounds per square yard of precoated limestone chips. The application rate shall be set to prevent bleeding of the asphaltic material through the cover aggregate. If material is spread on any area in excess of the amount specified by the Engineer, the surplus shall be immediately removed and placed elsewhere as directed. No payment will be made to the Contractor for the picking up and redistribution of such excess. Hand spreading will be permitted only in those areas not accessible to the mechanical spreader.

Immediately after spreading the cover aggregate, the entire surface shall be rolled with multiple-wheel, pneumatic-type rollers meeting the requirements of Section 1400. Rolling shall be continued until a thoroughly compacted surface with a uniform aggregate coverage has been obtained, a minimum of 6 passes. The Engineer may require additional rollers if one roller cannot keep up with the operations. The first pass of the rollers over the cover aggregate shall not exceed 3 miles per hour. The rollers shall not exceed 5 miles per hour during any rolling operation.

Forty-eight hours after spreading the cover aggregate, the entire surface shall be swept with a mechanical pickup type sweeper to remove any loose or excess cover aggregate.

During the sealing operation as described above, the Contractor shall cooperate with the Engineer in arranging a program and schedule of work so traffic may be handled or routed around or through the section being sealed. Whenever possible, the street will be closed; but when this is not possible, the sealing will be done in strips while traffic is diverted to the balance of the street. No traffic will be permitted on the sealed portion of the roadway until rolling is completed. All traffic control signage shall conform to the MUTCD handbook for traffic control in work zones. When bleeding occurs or more material is required, additional cover aggregate shall be spread as directed. As soon as the cover material has adhered to the surface, and the emulsion is thoroughly cured all excess cover aggregate shall be removed with a mechanical pickup type sweeper. This curing period is generally 48 hours, but may be adjusted by the Engineer.

## 2604 UNIMPROVED STREET CHIP SEAL

A. Description: This work shall consist of the application of a thin, uniform layer of liquefied asphalt to the surface of the existing roadway which may either consist of an existing surface of asphaltic concrete pavement or a gravel surfaced road. Cover aggregate shall then be distributed uniformly upon the liquefied asphalt and seated in place with the use of a rubber-tired roller leaving a durable wearing surface.

B. Requirements for Liquefied Asphalt Materials

Asphaltic materials used for the sealing of unimproved streets shall be liquefied either by the introduction of a diluent (cutback) or by emulsification. The particular grade of cutback material for use on a particular roadway shall be determined by the Engineer. Cutback asphaltic materials shall comply with the requirements of either ASTM D 2027 or ASTM D 2028. The particular grade of emulsified asphalt material for use on a particular roadway shall be determined by the Engineer. Anionic emulsified asphaltic materials shall comply with the requirements for either a rapid or medium-setting emulsion as described in ASTM D 977 while cationic emulsified asphaltic materials shall comply with the requirements for either a medium or rapid-setting emulsion as described in ASTM D 2397.

C. Requirements for Cover Aggregate Materials

1. Aggregate materials shall consist of an approximately cubical and uniformly-sized, hard, durable 100 percent crushed and washed limestone, sandstone, lightweight aggregate, basalt/porphyry, granitic material, steel slag, gravel, or chat. Chat is a by-product from the production of lead and zinc from the area located in southwestern Missouri, northeastern Oklahoma, and southeastern Kansas. Lightweight aggregate shall consist of expanded shale. Due to the variation in specific gravities between these materials, the application rate will need to be adjusted to reflect the change in specific gravity. The application rates reported in these specifications is for the Bethany Falls Limestone in the Kansas City area. The specific gravity of this material is approximately 2.58.

2. Physical properties required of the aggregate materials:

| | |
|---|---|
| Los Angeles Abrasion (ASTM C 131) | 35% loss (maximum) |
| Soundness using Mag. Sulfate (ASTM C88, 5 cycles) | 18% loss (maximum) |
| Soundness using Sodium Sulfate (ASTM C 88, 5 cycles) | 12% loss (maximum) |
| Total Shale, clay, coal, and lignite content (ASTM C 142) | 0.5% by weight (max) |
| Absorption | 4.0% (max) |

Aggregate chips applied to cutback asphalt shall be shown to have a moisture content less than 1 percent immediately prior to application. Aggregate chips applied to emulsified asphalt shall be shown to have a moisture content of 3 percent or less immediately prior to application.

Gradation for aggregate chips used for Single sealing:

Gradation for aggregate chips used for the first application of a Double sealing:

| Square Sieve Size | Percent Passing |
|---|---|
| 3/4” (19mm) | 100 |
| 1/2” (12.5mm) | 90 to 100 |
| 3/8” (9.5mm) | 40 to 70 |
| No. 4 (4.75mm) | 0 to 15 |
| No. 10 (2.0mm) | 0-2 |

Gradation for aggregate chips used for the second application of a Double sealing shall conform to the gradation for a Single sealing above.

a. The Contractor shall furnish scales for weighing cover aggregate as required in MoDOT Standard Specifications, Section 310. All loads of cover aggregate will be weighed as required, and evidenced by approved delivery tickets showing the net weight in pounds for each load. Two copies of each ticket shall accompany the load to the work site. In order for the load to be received and incorporated into the work, both copies will be signed by the Engineer (or inspector) and one of these copies returned to the Contractor.

D. Sealing

Sealing shall be accomplished in the same manner as described in Section 1300 except as modified herein. Where a seal coat is applied to a gravel-surface roadway the surface shall be prepared in accordance with Section 2600. The surface shall then be primed in accordance with Section 1300 prior to the application of the seal coat.

The application rate of cutback asphalt shall be in the range 0.25 to 0.45 gallons per square yard as directed by the Engineer or demonstrated to result in a satisfactory seal in a test strip provided by the Contractor. Anti-Strip agent may be added to Cutback Asphalt at a rate not to exceed 1 percent of the residual asphalt volume as directed by the Engineer in order to improve adhesion of the asphalt to the moist aggregates. The cutback agent shall be thoroughly mixed and blended with the cutback asphalt. The application rate of emulsified asphalt shall be in the range of 0.28 to 0.40 gallons per square yard as approved or directed by the Engineer. The distributor used shall meet the requirements of Section 1300.

Limestone materials shall be spread at the rate specified by the Engineer with the range of 16 to 24 pounds per square yard.

Where double sealing is indicated on the Plans or required by the Engineer, the area shall be treated with two seal coats. The application rate of the asphaltic material for the first application shall be approximately one-half of that used for a single seal with the remainder applied during the second seal application. The application rate of the first application of cover aggregate shall be within the range specified for a single seal. The application rate of the second application shall be approximately one-half the application rate of the first layer.

## 2605 IMPROVED STREET SLURRY SEAL

A. Description: This work shall consist of the application of Slurry Seal Material to an existing surface. The Slurry Seal shall consist of a mixture of emulsified asphalt, mineral aggregate and potable water, properly proportioned, mixed and spread on the surface in accordance with this specification and as directed by the Engineer.

B. Material

1. Emulsified Asphalt: The emulsified asphalt shall conform to Grade SS-1h of ASTM D 977, for emulsified asphalt, or Grade CSS-1h of ASTM D 2397, for cationic emulsified asphalt. Quick-set emulsified asphalts QS-1h and CQS-1h may also be used. They shall conform to ASTM D 977 and ASTM D 2397 respectively, except that the test requirements for cement mixing and storage stability shall not apply. Refer to the International Slurry Surfacing Association (ISSA) Bulletin No. 139. The emulsified asphalt shall have not less than 60% residue after distillation when tested using ASTM D 244 and shall have a penetration of between 40 and 90 when tested using ASTM D 2397 at 77° F. Each load of emulsified asphalt delivered shall have a certificate of analysis/compliance matching the material used in the mix design.

2. Aggregate for Slurry Seal: The mineral aggregate used for this work shall be natural or manufactured crushed granite, slag, or chat which is a byproduct of the milling of lead and zinc ores and shall conform to one of the following grading requirements when tested in accordance with ASTM C 136 and ASTM C 117. All aggregate shall conform to the quality requirements of ASTM D 1073.

3. Mineral Filler: Mineral Fillers are of two types, chemically active and chemically inactive. Both shall conform to ASTM D 242. Chemically active mineral fillers such as Portland cement, hydrated lime, and ammonium sulfate are used to improve workability, regulate the setting time, and, in some cases, to alter the aggregate gradation. Chemically inactive mineral fillers such as limestone dust, fly ash, and rock dust are used mainly to alter aggregate gradation.

| **GRADING REQUIREMENTS FOR AGGREGATE** | | | |
|---|---|---|---|
| Sieve Size | Amount Passing Sieves, Weight % | | |
| | Type I | Type II | Tolerance |
| 3/8 inch (9.5 mm) | 100 | 100 | |
| No. 4 (4.75 mm) | 100 | 90-100 | +/- 5% |
| No. 8 (2.36 mm) | 90-100 | 65-90 | +/- 5% |
| No. 16 (1.18 mm) | 65-90 | 45-70 | +/- 5% |
| No. 30 (600 um) | 40-65 | 30-50 | +/- 5% |
| No. 50 (300 um) | 25-42 | 18-30 | +/- 4% |
| No. 100 (150 um) | 15-30 | 10-21 | +/- 3% |
| No. 200 (75 um) | 10-20 | 5-15 | +/- 2% |

The percent passing the No. 200 (75 um) sieve shall be determined by ASTM C 117.

4. Water: All water used shall be potable and shall be free of harmful salts or contaminates.

5. Mix Design: The Engineer shall approve all slurry seal materials and methods prior to mixing and application. The Contractor shall submit a completed and tested slurry seal mix design for the Engineer's approval. The approved test method for emulsified asphalt slurry seal shall be found in ASTM D 3910. The mix design shall be made

with the same materials the Contractor will be using on the project. The percentage of each material must be shown on the mix design. Proportions of the mixture shall be as follows unless variations are approved by the Engineer:

| | **TYPE I** | **TYPE II** |
|---|---|---|
| **Aggregate for Slurry Seal** | 8.0 to 12.0 lbs. per sq. yd.<br>3.63 to 5.44 kg/m2<br>(dry basis) | 13.5 to 16.5 lbs. per sq. yd.<br>7.32 to 8.95 kg/m2<br>(dry basis) |
| **Emulsified Asphalt (Residual Asphalt Content)** | 10.0 to 16.0% by weight of dry aggregate | 7.5 to 13.5% by weight of dry aggregate |
| **Mineral Filler** | 1.5 to 3.0% by weight of dry aggregate | 1.5 to 3.0% by weight of dry aggregate |
| **Water** | Minimum amount necessary to obtain a fluid and homogenous mixture | Minimum amount necessary to obtain a fluid and homogenous mixture |

Once the proper consistency is obtained, changes in proportioning of the various components of the mixture shall be held to a minimum.

6. Application Rates: The slurry seal mixture shall be of proper consistency at all times so as to provide the application rate required by the surface condition and shall be in accordance with the following:

   Type I: 8.0 to 12.0 lbs. per sq. yd.
   Type II: 13.5 to 20 lbs. per sq. yd.

   Application rates are affected by the unit weight of the aggregate, the gradation of the aggregate and the demand of the surface to which the slurry seal is being applied.

7. Equipment: The slurry mixing machine shall be a continuous flow mixing unit and shall be capable of delivering accurately a predetermined proportion of aggregate, water and asphalt emulsion to the mixing chamber and to discharge the thoroughly mixed product on a continuous basis. The equipment shall be capable of pre-wetting the aggregate immediately prior to mixing with the emulsion. The mixing unit of the mixing chamber shall be capable of thoroughly blending all of the components together without violent mixing. The mixing machine shall be equipped with an approved fines feeder that includes an accurate metering device or method to introduce a predetermined proportion of mineral filler into the mixer. The mineral filler shall be fed at the same time and location as the aggregate. The fines feeder shall be required whenever added mineral filler is a part of the aggregate blend. The mixing machine shall be equipped with a water pressure system and fog-type spray

bar, adequate for complete fogging of the surface receiving slurry treatment. Attached to the mixer machine shall be a mechanical type squeegee distributor, equipped with flexible material in contact with the surface of the pavement to prevent loss of slurry from the distributor. It shall be maintained so as to prevent loss of slurry on varying grades and crown by adjustments to insure uniform spread. There shall be a steering device and a flexible strike-off. The spreader box shall have an adjustable width. The box shall be kept clean and build-up of asphalt and aggregate on the box or in the corners shall not be permitted. Use of burlap drags or other drags shall be approved by the Engineer. Hand squeegees, shovels, and other equipment shall be provided if necessary to supplement the slurry mixing machine. Power brooms, power blowers, air compressors, and hand brooms suitable for cleaning the surface and cracks of the existing surface shall be implemented to provide a clean surface.

8. Construction Requirements

a. Surface Preparation: Immediately prior to applying the slurry, clean the surface of all loose material, mud spots, vegetation, and other objectionable material. Any standard cleaning method used to clean pavements will be acceptable except water flushing. A pickup sweeper must be used unless otherwise approved by the Engineer. Manholes, valve boxes, drop inlets, and other service entrances shall be protected from the slurry seal by a method approved by the Engineer.

b. Application: The surface shall be pre-wetted by fogging ahead of the slurry box unless waived by the Engineer. Water used in pre-wetting the surface shall be applied at such a rate that the entire surface is damp with no apparent flowing water in front of the slurry box. The slurry mixture shall be of the desired consistency upon deposit on the surface and no additional elements shall be added. Total time of mixing shall not exceed four (4) minutes. A sufficient amount of slurry shall be carried in all parts of the spreader at all times so that a complete coverage is obtained. Overloading of the spreader shall be avoided. No lumping, balling, or unmixed aggregate shall be permitted. No segregation of the emulsion and aggregate fines from the coarse aggregate shall be permitted. If the coarse aggregate settles to the bottom of the mix, the slurry shall be removed from the pavement. No excessive breaking of emulsion shall be allowed in the spreader box. No streaks, such as those caused by oversized aggregate will be left in the finished pavement.

c. Hand Work: Approved squeegees shall be used to spread slurry in areas not accessible to the slurry mixer. Care should be exercised in leaving no unsightly appearance from the hand work.

d. Curing: Treated areas shall be allowed to cure for four hours, or until such time as the Engineer permits their opening to traffic.

e. Weather Limitation: The slurry seal shall not be applied if either the pavement or air temperature is below 60° F and falling. The mixture shall not be applied

if the relative humidity exceeds 80%.

f. Traffic Control: Suitable methods shall be used to protect the slurry from all types of traffic until sufficiently cured to accept traffic. The length of time before traffic is permitted to use the surface depends on the type of emulsified asphalt, mixture characteristics, and weather conditions.

g. Lines: Care shall be taken to insure straight lines along curb and shoulders. No runoff on these areas will be permitted. Lines at intersections will be kept straight to provide good appearance.

h. Property Owners Notification: The Contractor shall supply and place door tags on the doors of all involved property owners. The door tag language shall be approved by the Engineer.

i. Provisions for Public Convenience During Sealing Operation: The Contractor shall provide and maintain sufficient signs, barricades, warning lights, flag persons and watch persons to protect the work and public in a manner satisfactory to the Engineer. Any areas damaged prior to acceptance by the Engineer shall be repaired at the Contractor's expense. "No Parking" signs will be furnished by the Contractor. These signs shall comply with the standards established by the MUTCD with regard to size, color, working height and placement. When "No Parking" signs are posted on the streets with parking meters, the Contractor shall cover the parking meter heads with cloth or paper bags. The Contractor shall take all necessary precautions to protect the public (pedestrian and vehicular) from flying debris. The Contractor shall use warning signs and devices to warn motorists and pedestrians of work ahead

## 2606 IMPROVED STREET MICRO-SURFACING

A. Description: This work shall consist of the application of a polymer modified asphalt emulsion, mineral aggregate, mineral filler, potable water, and other additives, properly proportioned, mixed and spread on a paved surface in accordance with this specification and as directed by the Engineer.

B. Materials

1. Emulsified Asphalt: The emulsified asphalt shall be a quick wet polymer modified asphalt emulsion conforming to the requirements specified in ASTM D 2397 or AASHTO M 208 for Grade CSS-1h. The cement mixing test shall be waived for this emulsion. The polymer material shall be milled or blended into the asphalt or emulsifier solution prior to the emulsification process. The emulsified asphalt shall have not less than 62% residue after distillation when tested using ASTM D 244. The temperature for this test shall be held below 280° F. Higher temperatures may cause the polymers to break down. In addition, the emulsified asphalt shall have a penetration of between 40 and 90 when tested using ASTM D 2397 at 77° F (25° C)

and shall have a minimum softening point of 135° F when tested using ASTM D 36. Each load of emulsified asphalt delivered shall have a certificate of analysis/compliance matching the material used in the mix design.

2. Aggregate for Micro-Surfacing: The aggregate shall be a manufactured crushed stone such as granite, or chat which is a by-product of the milling of lead and zinc ores. The aggregate shall be totally crushed with 100% of the parent aggregate being larger than the largest stone in the gradation to be used. The mineral aggregate used shall conform to one of the following grading requirements when tested in accordance with ASTM C 136 and ASTM C 117. All aggregate shall conform to the quality requirements of ASTM D 1073.

| **GRADING REQUIREMENTS FOR AGGREGATE** | | | |
|---|---|---|---|
| Sieve Size | Amount Passing Sieves, Weight % | | |
| | Type I | Type II | Tolerance |
| 3/8 inch (9.5 mm) | 100 | 100 | |
| No. 4 (4.75 mm) | 90-100 | 70-90 | +/- 5% |
| No. 8 (2.36 mm) | 65-90 | 45-70 | +/- 5% |
| No. 16 (1.18 mm) | 45-70 | 28-50 | +/- 5% |
| No. 30 (600 um) | 30-50 | 19-34 | +/- 5% |
| No. 50 (300 um) | 18-30 | 12-25 | +/- 4% |
| No. 100 (150 um) | 10-21 | 7-18 | +/- 3% |
| No. 200 (75 um) | 5-15 | 5-15 | +/- 2% |

The combined aggregate prior to the addition of any chemically active mineral filler shall have a sand equivalent of not less than 65 when tested by ASTM D 2419. The aggregate shall have a weighted average loss not greater than 25% using magnesium sulfate when tested by ASTM C 88. Testing of abrasion resistance shall not exceed 30% when tested by ASTM C 131.

3. Mineral Filler: Mineral filler shall be any recognized brand of non-air entrained Portland cement or hydrated lime. The mineral filler shall be free of lumps and accepted upon visual inspections. The type and amount of mineral filler needed shall be determined by a laboratory mix design and will be considered as part of the aggregate gradation.

4. Water: All water used shall be potable and shall be free of harmful salts or contaminates.

5. Additives may be added to the emulsion mix or any of the component materials to provide the control of the quick-traffic properties. They must be included as part of the mix design and be compatible with the other components of the mix.

6. Mix Design: The Engineer shall approve all micro-surfacing materials and methods prior to mixing and application. The Contractor shall submit a completed and tested micro-surfacing mix design for the Engineer's approval. The approved test method

for micro-surfacing shall be found in ASTM D 6372. The mix design shall be made with the same materials the Contractor will be using on the project. The percentage of each material must be shown on the mix design. Proportions of the mixture shall be as follows unless variations are approved by the Engineer.M C 88.

| | **TYPE I** | **TYPE II** |
|---|---|---|
| **Aggregate for Micro-surfacing** | 10.0 to 20.0 lbs. per sq. yd. 4.53 to 9.07 kg/m2 (dry basis) | 13.5 to 16.5 lbs. per sq. yd. 7.32 to 8.95 kg/m2 (dry basis) |
| **Emulsified Asphalt (Residual Asphalt Content)** | 7.5 to 13.5% by weight of dry aggregate | 7.5 to 13.5% by weight of dry aggregate |
| **Polymer Based Modifier** | Minimum of 3% solids based on asphalt weight content | Minimum of 3% solids based on asphalt weight content |
| **Additive** | As needed | As needed |
| **Mineral Filler** | 1.5 to 3.0% by weight of dry aggregate | 0.0 to 3.0% by weight of dry aggregate |
| **Water** | Minimum amount necessary to obtain a fluid and homogenous mixture | Minimum amount necessary to obtain a fluid and homogenous mixture |

Once the proper consistency is obtained, changes in proportioning of the various components of the mixture shall be held to a minimum.

7. Application Rates: The Micro-Surfacing mixture shall be of proper consistency at all times so as to provide the application rate required by the surface condition and shall be in accordance with the following:

Type II: 10.0 to 20.0 lbs. per sq. yd.
Type III: 15.0 to 30.0 lbs. per sq. yd.

Application rates are affected by the unit weight of the aggregate, the gradation of the aggregate, and the demand of the surface to which the micro-surfacing is being applied.

8. Equipment:

a. Micro-Surfacing Mixing Equipment: The micro-surfacing mixing machine shall be specifically designed and manufactured to lay micro-surfacing. The machine shall be self-propelled, continuous flow mixing unit able to accurately deliver and proportion the aggregate, emulsified asphalt, mineral filler, control setting additive, and water to a revolving multi-blade double-shafted mixer and discharge the mixed product on a continuous flow basis.

The machine shall have sufficient storage capacity for aggregate, emulsified asphalt, mineral filler, control additive, and water to maintain an adequate supply to the proportioning controls. On major highway work, the machine may be required to be a self-loading machine capable of loading materials while continuing to lay micro-surfacing. The self-loading machine shall be equipped to allow the operator to have full control of the forward and reverse speed during application of the micro-surfacing material and be equipped with opposite side drivers stationed to assist in alignment. The self-loading device, opposite side driver's stations, and forward and reverse speed controls shall be original equipment manufacturer designed.

b. Proportioning Devices: Individual volume or weight controls for proportioning each material, and used in material calibration, shall be provided and properly marked.

c. Calibration: Each mixing unit to be used in the performance of the work shall be calibrated prior to construction. Calibration documentation shall include an individual calibration of each material at various settings, which can be related to the machine metering devices. No machine will be allowed to work on the project until a calibration has been completed. Final calibration sheets shall be provided to the Engineer for acceptance.

d. Micro-Surfacing Spreading Equipment: The machine shall include a surfacing box with twin- American Public Works Association 58 February 2017 Kansas City Metropolitan Chapter shafted paddles or spiral augers fixed in a spreader box. A flexible front seal shall be provided to insure no loss of mixture at the road surface contact point. The rear flexible seal shall act as a final strike-off and shall be adjustable in width. The spreader box and rear strike-off shall be so designed and operated that a uniform consistency is achieved to produce a free flow of material to the rear strike-off box. The box shall have suitable means provided to side-shift the box to compensate for variations of pavement geometry. A secondary strike-off shall be provided to improve the surface texture. It shall have the same leveling adjustments as the spreader box.

e. Auxiliary Equipment: Hand squeegees, shovels, traffic control equipment, and other support and safety equipment shall be provided as necessary to perform the work.

f. Cleaning Equipment: Power brooms, pickup sweepers, power blowers, air compressors, and hand brooms suitable for cleaning shall be utilized to provide a clean surface.

9. Construction Requirements

a. Surface Preparation: Immediately prior to applying the micro-surfacing, the surface shall be cleaned of all loose material, silt spots, vegetation, and

objectionable material as determined by the Engineer. Any standard cleaning method used to clean pavements will be acceptable except water flushing. Manholes, valve boxes, drop inlets, and other service entrances shall be protected from the micro-surfacing by a method approved by the Engineer.

b. Application: If the pavement area to be covered is extremely oxidized and raveled or is concrete or brick, a tack coat may be required at the discretion of the Engineer. The tack coat shall conform to Section 1300 and shall be a SS or CSS grade. The tack coat shall be allowed to break sufficiently before the application of micro-surfacing. The surface shall be pre-wetted by fogging ahead of the spreader box unless waived by the Engineer. Water used in pre-wetting the surface shall be applied at such a rate that the entire surface is damp with no apparent flowing water in front of the spreader box. The micro-surfacing mixture shall be of the desired consistency upon deposit on the surface and no additional elements shall be added. A sufficient amount of material shall be carried in all parts of the spreader box at all times so that a complete coverage is obtained. Overloading of the spreader box hall be avoided. No lumping, balling, or unmixed aggregate shall be permitted. No streaks, such as those caused by oversized aggregate shall be left in the finished surface.

c. Hand Work: Areas which cannot be reached with the mixing machine shall be surfaced using approved hand squeegees to provide a complete and uniform coverage. If necessary, the area to be hand-worked shall be lightly dampened prior to mix placement. The same type of finish as applied by the spreader box shall be required.

d. Curing: Micro-surfacing shall be allowed to cure for one hour, or until the Engineer permits opening the street to traffic.

e. Weather Limitation: Micro-surfacing shall not be applied if either the pavement or air temperature is below 60° F and falling. The mixture shall not be applied if the relative humidity exceeds 80%.

f. Traffic Control: Suitable methods shall be used to protect the micro-surfacing from all types of traffic until sufficiently cured to accept traffic. The length of time before traffic is permitted to use the surface shall be determined by the Engineer.

g. Lines: Care shall be taken to insure straight lines along curb and shoulders. No runoff on these areas will be permitted. Lines at intersections will be kept straight to provide good appearance.

h. Property Owners Notification: The Contractor shall supply and place door tags on the doors of all involved property owners. The door tag language shall be approved by the Engineer.

i. Provisions for Public Convenience During Surfacing Operation: The Contractor shall provide and maintain sufficient signs, barricades, warning lights, flag persons and watch persons to protect the work and public in a manner satisfactory to the Engineer. Any areas damaged prior to acceptance by the Engineer shall be repaired at the Contractor's expense. "No Parking" signs will be furnished by the Contractor. These signs shall comply with the standards established by the MUTCD with regard to size, color, working height and placement. When "No Parking" signs are posted on the streets with parking meters, the Contractor shall cover the parking meter heads with cloth or paper bags. The Contractor shall take all necessary precautions to protect the public (pedestrian and vehicular) from flying debris. The Contractor shall use warning signs and devices to warn motorists and pedestrians of work ahead.

## 2607 METHOD OF MEASUREMENT

A. Asphaltic Crack Seal will be measured per pound.

B. Chip seal will be measured by one of the following:

1. Per square yard or tenth part thereof.

2. Actual quantities used:

a. Asphaltic concrete patch, per ton or tenth part thereof
b. Bitumen (asphaltic cement or liquid asphalt) per gallon.
c. Coated cover aggregate, per ton or tenth part thereof.

C. Slurry seal will be measured per square yard or tenth part thereof.

D. Micro-surfacing will be measured per square yard or tenth part thereof.

## 2608 BASIS OF PAYMENT

A. Asphaltic Crack Seal will be paid for by one of the following:

1. Contract unit bid price.

2. Contract lump sum bid price.

B. Chip Seal will be paid for by one of the following:

1. Contract unit bid price.

2. Contract lump sum bid price.

C. Slurry Seal will be paid for by one of the following:

1. Contract unit bid price.

2. Contract lump sum bid price.

D. Micro-surfacing will be paid for by one of the following

1. Contract unit bid price.

2. Contract lump sum bid price.

# SECTION 3000 MATERIALS AND CONSTRUCTION - SANITARY SEWERS

3001 GENERAL. Sanitary sewer construction shall consist of furnishing all labor, materials and equipment for the complete installation of sewers and appurtenances.

3002 SPECIFICATION MODIFICATIONS. It is understood that throughout this section these specifications may be modified or deleted by appropriate items in the approved drawings.

3003 MATERIALS AND TESTING.

The manufacturers shall be experienced in the design, production and commercial supplying of the specific material. Testing is to be performed by the manufacturer's quality control personnel in conformance with applicable standards.

Testing may be witnessed by Owner, Engineer, or approved independent testing laboratory. Upon request of the Owner, and prior to delivery, the Contractor shall provide three (3) copies of certified test reports indicating the material does conform to the specifications.

No pipe or fitting shall be delivered until approved by the Materials Laboratory and are so marked. The manufacturer and contractor shall use equipment and methods adequate to protect pipe, joint elements and prevent shock contact of adjacent units during moving or storage. Damaged sections that cause reasonable doubt as to their structural strength or water tightness will be rejected.

3004 MATERIALS. Sanitary sewers shall be constructed of pipe material resistant to or protected from bacterial degradation, acid and alkaline solutions, normal sewer temperature variation, abrasion, and industrial wastes or other material, which may be transmitted by the collection system.

All materials shall be furnished as indicated and specified including pipe type, joint types, sizes, and strength classes. Higher strengths may be furnished at the Contractor's option and at no additional cost to the Owner.

The following types of commercial pipe are approved for gravity sanitary sewer systems constructed in the City of Branson.

| **Pipe Type** | **Approved Standard** |
|---|---|
| Ductile Iron | ANSI/AWWA C151/A21.51; ASTM A536, Grade 50-42-10; thickness Class 50, unless otherwise approved by the director of public works/engineering |
| PVC Pipe, less than 15' of cover | ASTM D3034, Type PSM PVC (Polyvinyl Chloride), SDR 35; PVC material shall conform to ASTM D and shall have a cell classification of 12454-B, 12454-C, or 13364-B. |
| PVC Pipe, over 15' of cover | PVC pipe meeting the requirements of AWWA C-900. |
| PVC Pipe, Service Lines | Schedule 40 |


| **Pipe Type** | **Approved Standard** |
|---|---|
| Ductile Iron | ANSI/AWWA C151/A21.51; ASTM A536, Grade 50-42-10; thickness Class 50, unless otherwise approved by the director of public works/engineering |
| PVC Pipe, less than 15' of cover | ASTM D3034, Type PSM PVC (Polyvinyl Chloride), SDR 35; PVC material shall conform to ASTM D and shall have a cell classification of 12454-B, 12454-C, or 13364-B. |
| PVC Pipe, over 15' of cover | PVC pipe meeting the requirements of AWWA C-900. |
| PVC Pipe, Service Lines | Schedule 40 |


A. DUCTILE-IRON PIPE. Conform to ANSI/AWWA C151/A21.51; ASTM A536, Grade 50-42-10, except as otherwise specified herein.

1. Design. Design of pipe shall be in accordance with ANSI A21.50 laying conditions S, Type 2 or 3. Minimum wall thickness shall be Class 50.

2. Joints. Mechanical and push-on joints for ductile-iron pipe and fittings shall conform to the requirements of ANSI A21.11. Gaskets shall be neoprene or other synthetic rubber material. Natural rubber gaskets will not be acceptable.

3. Fittings. Fittings shall be in accordance with ANSI/AWWA C111/A21.10 and shall have a pressure rating of not less than that specified for pipe. Fittings used with ductile-iron pipe shall be ductile-iron or cast iron. Fittings for pipe with mechanical joints shall have mechanical joints. Fittings for pipe with push-on joints shall be either mechanical joint or push-on joint.

4. Lining & Coating.

1. Non-Septic Sewers. All ductile-iron pipe, fittings and specials shall be cement mortar lined in accordance with ANSI/AWWA C104/A21.4 for non-septic sewers. Coat all pipe, fittings and specials with manufacturers' standard coal tar coating.
2. Septic Sewers. All ductile-iron pipe, fittings and specials shall be lined with an epoxy lining with a thickness of 40 mil. Lining must be approved for the use within septic sewers per manufacturer specifications.

B. POLY-VINYL CHLORIDE (PVC) SEWER PIPE. Conform to ASTM D3034, except as otherwise specified herein.

1. General. Furnish maximum pipe lengths manufactured by the supplier, except for fitting, closures and specials.

2. Design. The minimum wall thickness for PVC Pipe shall conform to SDR-35. PVC pipe having a cover to finish grade of fifteen feet (15') or more shall conform to AWWA C900. Pipe bedding shall conform to ASTM D2321 for Class I materials.

3. Joints. Flexible gasketed joints shall be compression type with a gasket confined in a machined groove in the spigot end of the pipe. Oil resistant rubber gasket rings shall conform to the requirements of ASTM D1869. Gaskets shall be neoprene or other synthetic material. Natural rubber gaskets are not acceptable.

4. Fittings. Fittings defined as tee or wye connections suitable for assembly to four inch (4") or six inch (6") service stub lines shall meet the specifications listed in Section 3005.

3005. SERVICE STUB LINES. Shall conform to the Branson Municipal Code. See Standard Detail Drawing.

A. Minimum 4" Schedule 40 PVC solid core pipe. Cellular core is not allowed.

B. Minimum cover of eighteen 18 inches from top of pipe to finished grade.

C. Trenching and Bedding: Install three-quarter inch (¾") to one inch (1") clean crushed stone aggregate, a minimum three inches (3") below pipe and six inches (6") above pipe. Trench

width for all installations shall be a minimum of three (3) times the diameter of the pipe.

D. Fitting Requirements: All fittings shall correlate with the pipe type and O.D.

1. No 90 degree ells or sweeps allowed.

2. No fernco or "no-hubs" allowed on PVC to PVC pipe connections.

3. Bell and spigot pipe must be installed with the spigot end facing downstream.

E. Cleanouts: Required at the right-of-way line or permanent easement line. If the sewer service line is eight inches (8") or less, the cleanout shall be the same size as the pipe it is servicing. The cleanout cap shall be a screw plug with a raised hex nut, or equal and covered with a concreted traffic rated lid.

The traffic rated lids shall be cast iron with a raised ring and solid cover.

i. A four inch (4") cleanout shall use a Deeter 1815 or approval equal.

ii. A six inch (6") cleanout shall use a General Foundries 11181 or approved equal.

iii. An eight inch (8") cleanout shall use a General Foundries 11181 or approved equal.

Concrete shall be formed in a square around the cleanout ring and lid a minimum of six inches (6") on all sides up to one foot (1') and be a minimum of six inches (6") thick. Concrete shall also be placed inside the cleanout ring and lid.

F. Connection to Main:

1. Connection shall be made above the center line of the main at 45 degrees or greater. saddles may be used (for existing sewer mains) while a WYE may be installed for all new main installations. Saddles on PVC mains shall be PVC glue-on type saddles with stainless steel straps. Saddles on clay or cast iron shall be GENECO Sealtite with gasket or approved equal. If a main is lined, a "top hat" is required to seal the broken liner.

2. Manhole connections are allowed when the sewer main is ten feet (10') in depth or greater. The connection must be made with an approved "A-LOK Inserta-LOK" type gasket or an approved equal.

a. drop must be provided with a tee installed in the direction of flow and an adequate number of stainless steel pipe clamps and hardware to fasten the drop to the manhole wall. See Standard Detail Drawing.

b. In such cases an outside drop is provided, it shall be supported at the bend

with concrete

G. Crossing of Public Water Mains: See Design Criteria.

3006. CONCRETE. Concrete, whether reinforced or non-reinforced, shall conform to MCIB Specifications and to the requirements set forth in Section 2000 "Concrete".

3007. REINFORCING STEEL. Reinforcing steel shall be placed as shown on the plans and shall conform to ASTM Specifications as follows:

A. Bars and rods shall be deformed billet-steel conforming to ASTM A615, Grade 40.

B. Welded wire fabric shall conform to ASTM A185, Grade 40.

C. Fabricated steel bar and rod mats shall conform to ASTM A184. Bar material shall conform to ASTM A615, Grade 40.

D. Smooth bars shall be round carbon steel bars conforming to ASTM A663, Grade 60.

3008. MANHOLES

3008.1. MATERIALS.

A. General. Manholes shall conform to the Standard Detail Drawings.

B. Precast Concrete. Precast concrete manholes shall conform to ASTM C 478. Joints shall be of material as specified for reinforced concrete pipe joints or a bitumastic material or preformed flexible joint sealants applied in accordance with manufacturer's recommendations.

C. Cast in Place Concrete. Concrete used shall conform to requirements set forth in Section 2000, "Concrete".

The bitumen shall consist of two coats of asphalt or coal-tar pitch. Asphalt shall conform to the requirements of ASTM D 449. Coal-tar pitch shall conform to the requirements of ASTM D 450.

D. Manhole Lining. Manholes with force main connections shall be lined with “FUTRA-THANE 5360 Structural Polyurea” or approved equal. The lining must be a minimum of 250 mils thick and protect against H2S corrosion.

3008.2. WATERTIGHTNESS. Manholes shall be watertight and constructed of precast concrete or poured-in-place concrete type. Precast manholes shall conform to the design and test methods specified by appropriate standards. Seal manhole lift holes, grade adjustment rings, precast section joints, and any additional areas potentially subject to infiltration

## 3008.3. MANHOLE CASTINGS.

A. General: Cast-iron rings, covers, and steps shall conform to the Standard Detail Drawings. Manhole rings and covers shall be Deeter No. 1247, or approved equal.

When bolt-down type manhole rings and covers are required and specified, Deeter No. 1247-B, or approved equal, with rubber gaskets and stainless steel cover bolts 5/8-inch diameter with hexagonal-head bolts shall be furnished. Bolt-down type manhole rings shall be anchored to the manhole with not less than four (4) 3/4-inch diameter anchor bolts having a minimum of 14 inches of embedment, except in concrete manholes in which the ring is embedded in concrete.

Cast iron manhole steps shall be Clay and Bailey, or approved equal, No. 2102 for precast concrete manholes and No. 2104 for concrete manholes.

Polypropylene coated steel reinforced "plastic steps" shall be M.A. Industries, Inc. model PS-2-PF or approved equal manhole step for precast concrete manholes.

The castings shall meet or exceed the following minimum requirements.

1. Iron castings shall conform to the requirements of ASTM A48, Class 25.

2. Castings shall be clean and whole, and without blow or sand holes or any other surface defects which would impair serviceability. Plugging or filling of holes or other defects will not be permitted.

3. Parting fins and pouring gates shall be removed.

4. Castings shall be cleaned and painted with one coat of coal tar before being delivered to the site.

## 3008.4 FLOWCHANNEL

The flow channel straight through a manhole should be made to conform as closely as possible in shape and slope to that of the connecting sewers. The channel walls should be formed or shaped to the full height of the crown of the outlet sewer in such a manner as to not obstruct maintenance, inspection, or flow in the sewers.

Changes in direction of flow should generally not exceed ninety degrees (90°).

Construct a separate channel for each incoming sewer with the channels gradually merging together ahead of the outlet using uniform curves where a junction of two (2) or more sewers occurs.

The invert of any trunk or interceptor sewer should be slightly lower than the invert of the sewer

main to avoid slack-water areas where solids may accumulate.

When curved flow channels are specified in manholes, including inlets, the minimum slopes indicated by the City of Branson Design Criteria and MDNR, should be increased to maintain acceptable velocities.

3008.5. BENCH

Provide a bench on each side of any manhole channel when the pipe diameter(s) are less than the manhole diameter. The bench should be sloped no less than one-half inch per foot (0.5 in/ft).

No sewer, service connection, or drop manhole pipe shall discharge on the surface of the bench

3009 BEDDING AND EMBEDMENT AGGREGATE. All materials used for pipe bedding and embedment shall be 3/4" to one inch (1") clean crushed stone aggregate only.

3010 CONSTRUCTION REQUIREMENTS.

A. Grading and Excavation.

1. Scope. Excavation and trenching work shall include the necessary clearing, grubbing, and preparation of the site; removal and disposal of all debris; excavation and trenching as required; the handling, storage, transportation and disposal of all excavated material; all necessary sheeting, shoring and protection work; preparation of subgrades; pumping and dewatering as necessary or required; protection of adjacent property; and other appurtenant work.
2. General. Excavation and trenching work shall be performed in a safe and proper manner with suitable precautions being taken against all hazards.

   The Contractor shall explore and expose any and all obstructions in advance of excavation so that minor changes in grade and alignment may be made.

   In paralleling present water and gas mains, the Contractor shall protect all service connections and shall arrange to furnish service to the consumers with minimum interruption.

   All excavated material shall be piled in a manner that will not endanger the work and that will avoid obstructing sidewalks and driveways. Gutters shall be kept clear or other satisfactory provisions made for street drainage.

3 Classification of Excavated Material. When specifically indicated in the proposal and contract, classification of excavated materials will be made as follows:

   a. Rock. Rock excavation will be so classified when sandstone, limestone, blue shale or other similar material is encountered and, in the opinion of the Engineer, requires drilling or blasting or remove the material.

b. Earth. All material not classified as rock.

4 Clearing. The Contractor shall do all clearing necessary for access, stringing of pipeline materials, and construction of the pipeline and appurtenant structures.

5. Unauthorized Excavation. Any part of the trench excavated below grade shall be corrected with material approved by the Engineer placed and compacted by the Contractor.

6 Dewatering. The Contractor shall provide and maintain adequate dewatering equipment to remove and dispose of all surface and groundwater entering excavations, trenches, or other parts of the work. Each excavation shall be kept dry during subgrade preparation and continually thereafter until the structure to be built, or the pipe to be installed therein, is completed to the extent that no damage from hydrostatic pressure, flotation or other cause will result.

All excavations for concrete structures or trenches which extend down to or below static groundwater elevations shall be dewatered by lowering and maintaining the groundwater surface beneath such excavations a distance of not less than 12 inches below the bottom of the excavation.

Surface water shall be diverted or otherwise prevented from entering excavated areas or trenches to the greatest extent practicable without causing damage to adjacent property.

The Contractor will be held responsible for the condition of any pipe or conduit which may be used for drainage purposes, and all such pipes or conduit shall be left clean and free of sediment.

Sanitary Sewers that ultimately arrive at existing pumping stations or wastewater treatment facilities cannot be used for the disposal of trench water.

7. Sheeting and Shoring. Except where banks are cut back on a stable slope, excavation for structures and trenches shall be properly and substantially sheeted, braced, or shored as necessary to prevent caving or sliding, to provide protection for workmen and the work, and to provide protection for existing structures and facilities. Sheeting, bracing and shoring shall be designed and built to withstand all loads that might be caused by earth movement of pressure and shall be rigid, maintaining shape and position under all circumstances.

Trench sheeting shall not be pulled unless pipe strength is sufficient to carry trench loads based on trench width to the back of sheeting. Sheeting shall not be pulled after backfilling. When ordered by the Engineer, wood sheeting shall be left permanently in the trench.

Where trench sheeting is left in place, such sheeting shall not be braced against

the pipe, but shall be supported in a manner which will preclude concentrated loads or horizontal thrusts on the pipe. Cross braces installed above the pipe to support sheeting may be removed after pipe embedment has been completed.

8. Stabilization. Trench bottoms shall be firm, dense, and thoroughly compacted and consolidated; shall be free from mud and muck; and shall be sufficiently stable to remain firm and intact under the feet of the workmen.

   Trench bottoms which are otherwise solid but which become mucky on top due to construction operations shall be reinforced with one or more layers of crushed stone or gravel. Not more than 1/2-inch depth of mud or muck shall be allowed to remain on stabilized trench bottoms when the pipe bedding material is placed thereon.

9. Trench Excavation. The Contractor shall not open more trenching advance of pipe laying than is necessary to expedite the work. One block or 300 feet whichever is the shorter, shall be the maximum length of open trench ahead of pipe laying unless by written permission of the Engineer.

   Except where tunneling or boring and jacking is specified and shown on the plan by the Engineer, all trench excavations shall be open cut.

10. Alignment and Grade. The alignment and grade or elevation of the pipeline shall be as shown on the plans.

    The Contractor must maintain a constant check of the pipe alignment and trench depth and will be held responsible for any deviations therefrom.

11. Limiting Trench Width. Trenches shall be excavated to a width which will provide adequate working space and pipe clearances for proper pipe installation, jointing, and embedment. Ledge rock, boulders, and large stones shall be removed to provide a clearance of six inches (6") below and on each side of all pipe. These distances are minimum clear distances which will be permitted between any part of the pipe and appurtenances being laid on any part, projection, or point of such rock, boulder, or stone.

    Cutting trench banks on slopes to reduce earth load to prevent sliding and caving will be permitted only in areas where the increased trench width will not interfere with surface features or encroach on right-of-way limits. Slopes shall not extend lower than one foot (1') above the top of the pipe.

    Limiting trench widths below an elevation of one foot (1') above the exterior top of the installed pipe shall be not less than fifteen inches (15") nor more than twenty-four inches (24") greater than the nominal outside diameter of the pipe.

12. Unauthorized Trench Widths. When, for any reason, the width of the lower portion of the trench as excavated at any point exceeds the maximum permitted in the foregoing, either pipe of adequate strength, special pipe embedment, or arch concrete

encasement, as required by loading conditions and as determined by the Engineer, shall be furnished and installed by and at the Contractor's expense.

13. Trench Bottom in Earth. All earth excavation shall be carried to a minimum of six inches (6") below the bottom of the pipe. Pipe bedding material shall be used to restore the trench bottom to the desired elevation and grade and to provide a uniform bearing and continuous support for the pipe along its entire length.

14. Rock Exploration. Unless shown otherwise on the plans or noted in the Special Provisions, no rock exploration has been made. On those projects where rock exploration has been made, test holes have been drilled at locations and intervals as shown on the plans or subsurface information report to determine the approximate location and depth of rock. Resistance to penetration was assumed to be "solid rock". This information is furnished for general reference purposes only.

15. Trench Bottoms in Rock. All rock excavation shall be carried to a minimum of six inches (6") below the bottom of the pipe. Pipe bedding material shall be used to restore the trench bottom to the desired elevation and grade and to provide a uniform bearing and continuous support for the pipe along its entire length. Care shall be exercised to prevent any portion of the pipe from coming to bear on solid rock or boulders.

16. Mechanical Excavation. The use of mechanical equipment will not be permitted in locations where its operations would cause damage to trees, buildings, culverts, or other existing property, utilities, or structures above or below ground. In all such locations, hand-excavating methods shall be used. Mechanical equipment used for trench excavation shall be of the type, design and construction and shall be so operated that the rough trench excavation bottom elevation can be controlled, that uniform trench widths and vertical sidewalls are obtained at least from the bottom of the trench, and that trench alignment will be centered in the trench with adequate clearance between the pipe and sidewalls of the trench. Undercutting the trench sidewall to obtain clearance will not be permitted.

    All mechanical trenching equipment, its operating conditions, and the manner of its operations shall be subject at all times to the approval of the Engineer.

17. Cover depth. The top of all sewers entering or crossing streams should be at a sufficient depth below the natural bottom of the stream bed to protect the sewer line. Design to meet the following cover depth:

    a. At least one foot (1') of cover where the sewer is located in rock;

    b. At least three feet (3') of cover in other stream bed material and in major streams; and

    c. In paved stream channels, the top of the sewer line should be placed below the bottom of the channel pavement.

B. Crossings.

1. Stream Crossings. Stream crossings shall be made in accordance with these specifications and as shown on the plans.

   The trench width shall be as required for proper pipe installation and the trench depth shall be as required to give minimum cover shown on the plans, Pipe encasement, where required, shall be in accordance with the specifications and placed as indicated on the plans.

2. Highway and Railroad Crossings. The Contractor shall make highway and railroad crossing in accordance with these specifications, special provisions of the authority having jurisdiction, and as shown on the plans.

   All construction or work performed and all operations of the Contractor, his employees, or his subcontractors within the limits of highway or railroad right-of-ways shall be in conformity with all the requirements, regulations and be under the control, through the Engineer of the authority owning or having jurisdiction over and control of the right-of-way.

   The Contractor shall pay fees and obtain permits to make the crossings unless otherwise directed.

3. Street Crossings. Open cutting of streets shall be allowed only where permitted by the Director of Public Works/Engineering. At locations where open cutting is not permitted, the crossing shall be made by boring or tunneling. Crossings made by boring or tunneling shall require a casing pipe unless otherwise approved by the city. All work and materials shall be in conformity with all requirements of the Technical Specifications of the City of Branson. 4. Boring or Tunneling. Crossings made by boring or tunneling shall require a casing pipe unless otherwise approved by the director of public works/engineering. The diameter and length of the casing pipe to be used shall be as determined by the director of public works/engineering. All work and materials shall be in conformity with all requirements of the Standard Detail Drawings. See Chapter 24 for approved materials.

C. Separation.

1. Vertical. Minimum 18 inches from any water line. If unable to meet minimum, pipe shall be encased in an approved casing with end seals
2. Horizontal. Minimum 10 feet from any water line. If unable to meet minimum, pipe shall be encased
3. Water work structures. Minimum of 50 feet horizontally from any existing or proposed public water supply well or other water supply sources or structures.
4. Dry Utilities. Minimum 7.5 ft. horizontal and 18 inch vertical or as approved by.

3011 HANDLING. Handle pipe materials and fittings in a manner to insure installation in sound

and undamaged condition. Do not drop or bump. Use slings, lifting lugs, hooks and other devices designed to protect pipe, joint elements and coatings. In handling plastic pipe of 10 feet in length or greater, a double sling will be required unless otherwise approved by the Engineer.

Materials shall be shipped, moved and stored with provisions to prevent movement or shock contact with adjacent units.

3012 INSTALLATION.

A. All work shall be in accordance with the following standards:
Flexible Thermoplastic Pipe: ASTM C600
PVC Pipe: Ductile Iron Water Mains: AWWA C600

B. Utilize equipment, methods and materials insuring installation to lines and grades indicated.

1. Maintain the following tolerances from true alignment and grade:

| | |
|---|---|
| Alignment | 3 inches |
| Grade | 1 inch |

Joint deflection shall not exceed the maximum allowable deflection per joint according to ASTM C 425, ASTM C 594 and AWWA C600. Only one correction for alignment and/or grade shall be made between adjacent manholes.

2. Except where pipe sections are being encased in concrete, no pipe is to be supported by blocks.

3. Accomplish curve alignments with bends, bevels, and open joints. Limit joint opening in concrete pipe to 3/8 inch in laying schedule and 1/2-inch in actual installation. Limit joint deflection with cast iron or ductile iron pipe which is not to exceed the maximum allowable deflection per joint according to ASTM C425, ASTM C594, and AWWA C600.

C. Install pipe of size, material, strength class, and joint type with embedment as shown on the Plans.

D. Insofar as possible, commence laying at downstream end of line and install pipe with spigot or tongue end downstream. Connection to downstream manhole shall not be made until newly installed piping has passed all tests. Service lines are not to connect to the sewer system until tests have passed on the main and/or manholes.

E. Clean interior of all pipe, fittings, and joints prior to installation. Exclude entrance of foreign matter during discontinuance of installation. Close open ends of pipe with snug fitting closures. Do not let water fill trench. Include provisions to prevent flotation should water control measures prove inadequate. Remove water, sand, mud and other undesirable materials from trench before removal of end cap.

F. Install pipe only when weather and trench conditions are suitable. Do not lay in water. Brace or anchor pipe as required to prevent displacement after establishing final position.

G. Where pipe is laid at a slope of 20% or greater, concrete slope anchors shall be installed.

3013 PIPE BEDDING AND EMBEDMENT. The sewer trench shall be carried to a point not less than six inches (6") below bottom of pipe bell or barrel Pipe bedding, compacted to the full width of trench, shall then be placed and compacted to bottom of pipe with proper allowance for bell joints or couplings. After each length of pipe being laid has been shoved "home" and placed in proper alignment, it shall be securely anchored and held in position by embedment extending to a point not less than 12 inches above the top of the pipe bell or coupling. If unstable subgrade conditions are encountered and it is determined by the Engineer than the bedding specified will not provide suitable support for the pipe, additional excavation to the limits determined by the Engineer will be required. This additional excavation shall be backfilled with material approved by the Engineer.

3014 JOINTING.

A. General Requirements.

1. Locate joints to provide for differential movement at changes in type of pipe embedment, concrete collars, and structures. Support pipe from wall of manhole at first joint in normal sewer trench with concrete cradle structurally continuous with base slab or footing.

2. Clean and lubricate all joint and gasket surfaces with lubricant recommended by pipe manufacturer.

3. Utilize methods and equipment capable of fully homing or making up joints without damage.

4. Check joint opening and deflection for specification limits.

5. Examine each piece of pipe prior to installation for soundness and specification compliance.

B. Provisions for Jointing Ductile Iron Pipe.

1. Conform to AWWA C600.

2. Paint suspected damaged portions with turpentine and dust with cement to check for cracks. Remove turpentine and cement by washing when crack test is satisfactorily completed. If cracks are found, the pipe shall be rejected.

3. Check gasket position and condition after assembly prior to installation of next pipe section.

C. Provisions for Jointing PVC Pipe. Check gasket for position and condition after assembly prior to installation of next pipe section.

3015 CUTTING. Cut in neat workman-like manner without damage to the pipe. Observe specifications regarding joint locations. Smooth cut by power grinding to remove burrs and sharp edges. Repair lining as required and approved.

3016 TEMPORARY PLUGS.

A. Plugs. Provide and install plugs as manufactured by pipe supplier or as fabricated by Contractor if approved. Plugs shall be water-tight against heads up to 20 feet of water. Secure plugs in place in a manner to facilitate removal when required to connect pipe.

B. Location. Plugs shall be installed as specified or where shown on Plans. Also the open end of the sewer shall be plugged at the end of the work day with a suitable mechanical plug to prevent entry of foreign material until work is resumed.

3017 CONNECTIONS TO EXISTING PIPELINES AND STRUCTURES.

A. Connections shall not be made to existing facility until all of the new system has been tested.

B. Connect pipe to existing structures and pipelines where indicated. Observe pertinent articles of specifications pertaining to joint locations.

C. Connections to existing structures shall be made by coring and installation of a flexible watertight seal per Standard Detail Drawings.

D. When sewer bypass is required, a plan of action shall be approved by the city for the bypass of the existing sewer to prevent disruption of service. When existing conditions do not permit a sewer bypass, alternative connection methods are to be approved by the city.

E. Connections to existing pipelines with a new manhole shall be made by removing a section of pipe and installing a pre-cast manhole within the removed section. The existing pipe shall then connect to the manhole. Any portion of the existing sewer damaged by the Contractor shall be repaired or replaced at no expense to the city. The Contractor shall notify the Utilities Department 36 hours prior to installation. City personnel must be on site while installation takes place. The manholes shall comply with the Standard Detail Drawings.

F. Connections between different pipe materials shall be made using proprietary transition coupling, unless otherwise specified on the Plans.

3018 TRACER WIRE. Tracer wire shall be installed with all sanitary sewer force mains and all sanitary service stub lines. The tracer wire and appurtenances shall be color coded per American Public Works Association (APWA) standard for the specific utility being marked.

A. Tracer Wire:

1. Open Trench. Tracer wire shall be a (14, 12 or 10 AWG SOLID HDPE 30 MIL)

copper conductor with a 30 mil thick, high-density, high molecular weight polyethylene (HDPE) insulation and rated for 30 volts. Insulation and jacket shall be RoHS compliant and utilize virgin grade material. Insulation color shall meet the APWA color code standard for identification of buried utilities. Tracer wire shall be Pro-Line Safety Products or approved equal and made in the USA.

2. Directional Drilling/Boring. Tracer wire shall be #12 AWG Copper Clad Steel, totally annealed 1055 steel. Extra high strength, minimum breaking load of 1,150 lbs., with a minimum HDPE coating of 45 mills.

3. Pipe Bursting. Tracer wire shall be #.2403" AWG Copper Clad Steel, totally annealed 1055 steel. Extreme strength, stranded, minimum breaking load of 4,700 lbs., with a minimum HDPE coating of 50 mills.

B. Location Tape: Marking tape shall be installed 12 inches above the pipe in paved areas and shall be green in color and have "Buried Sanitary Sewer Line Below" printed on the tape at 20 to 30 inch intervals. The tape shall be installed directly above the centerline of the pipe.

C. Connectors:

1. Direct bury wire connectors, including 3-way lockable connector: "Copperhead SnakeBite Locking Connectors" or approved equal. Mainline splice to service line connection shall be specifically manufactured for use in underground tracer wire installation, shall be dielectric silicon filled to seal out moisture and corrosion, and shall be installed in a manner so as to prevent any uninsulated wire exposure.

2. All mainline tracer wires must be interconnected in intersections, at tees and crosses. At tees, the three wires shall be joined using a single 3-way lockable connector. At crosses, the four wires shall be joined using a 4-way connector. Using two 3-way connectors with a short jumper wire between them is an acceptable alternative.

3. Directional drilling and pipe bursting splicing is not allowed on the main line. Intersection splicing will follow guidance for direct bury connectors.

D. Termination / Access: All tracer wire termination points must utilize an approved tracer wire access box. A minimum of two feet (2') of excess wire is required in all grade level trace wire access boxes after setting at final grade.

1. Service Stub lines: Access to the trace wire shall be through the cleanout located at the right-of-way line or permanent easement line. The tracer wire shall terminate at the sewer main connection point with an approved grounding anode. See Standard Detail Drawing.

2. Force Main: Access to the tracer wire shall be through a valve box at both ends of the force main. The tracer wire shall terminate at both ends with and approved grounding anode. See Standard Detail Drawing.

3. Low Pressure Main: Access to the tracer wire shall be through a valve box at both ends of the force main. The trace wire shall terminate at all dead ends with an approved grounding anode. See Standard Detail Drawing.

4. Low pressure stub lines shall have access to the trace wire through the valve box. The tracer wire shall connect to the low pressure main trace wire. See Standard Detail Drawing.

5. On long-runs, in excess of five hundred 500 linear feet without service lines, tracer wire access must be provided utilizing an approved in-ground tracer wire access box. The box must be located out of the roadway and delineated using a polyethylene marker post, color coded per American Public Works Association (APWA) standard for the specific utility being marked.

E. Grounding:

1. Tracer wire must be properly grounded at all dead ends/stubs.

2. Grounding of tracer wire shall be achieved by use of a drive-in magnesium grounding anode rod with a minimum of 20 linear feet of #14 AWG HDPE copper clad wire connected to the anode.

F. Installation General:

1. Tracer wire installation shall be performed in such a manner that allows proper access for connection of line tracing equipment, proper locating of wire without loss or deterioration of low frequency (512 Hz) signal for distances in excess of 1,000 linear feet, and without distortion of signal caused by multiple wires being installed in close proximity to one another.

2. Tracer wire system must be installed as a continuous single wire. No looping or coiling of wire is allowed.

3. Any damage occurring during installation of the trace wire must be immediately repaired in an approved waterproof method. Taping and/or spray coating shall not be allowed.

4. All mainline dead-ends shall go to ground using an approved waterproof connection to a drive-in magnesium grounding anode rod, buried at the same depth as the trace wire. The anode will be buried on the opposite side of the utility at the furthest most point. The anode wire will be connected in the trace wire access box to the trace wire utilizing the connection point in the access box.

5. Mainline tracer wire shall not be connected to existing conductive pipes. Treat as a mainline dead-end, ground using an approved waterproof connection to a grounding anode, buried at the same depth as the tracer wire.

6. All service stub line tracer wires shall be connected to the mainline with a single wire, (no looping will be allowed) using a mainline to lateral lug connector, installed without cutting/splicing the mainline tracer wire.

7. In occurrences where existing tracer wire is encountered on an existing utility that is being extended or tied into, the new and existing tracer wire shall be connected using approved splice connectors, shall be properly grounded at the splice location as specified and be completely waterproof to prohibit corrosion and loss of conductivity.

G. PROHIBITED PRODUCTS AND METHODS: The following products and methods shall not be allowed or acceptable.

1. Uninsulated tracer wire

2. Tracer wire insulations other than HDPE

3. Twist-on wire connectors

4. Brass or copper ground rods

5. Wire connections utilizing taping or spray-on waterproofing

6. Looped wire or continuous wire installations, that has multiple wires laid side-by-side or in close proximity to one another

7. Brass fittings with trace wire connection lugs

8. Wire terminations within the roadway

9. Connecting trace wire to existing conductive utilities

H. TESTING: All new tracer wire installations shall be located using typical low frequency (512 Hz) line tracing equipment, witnessed by city personnel, prior to acceptance of ownership. This verification shall be performed upon completion of rough grading and again prior to final acceptance of the project. Continuity testing in lieu of actual line tracing shall not be accepted.

## 3019 BACKFILL

### 3019.1 Trench Backfill.

A. General. Compacted backfill shall be required for the full depth of the trench above the embedment where beneath structures, street, road, or highway right-of-way, driveways, walks, parking areas, and at all locations shown on the plans or as directed by the Engineer during the progress of the work.

The top portion of the backfill beneath established sodded areas shall be finished with at least 12 inches of topsoil corresponding to, or better than, that underlying adjoining sodded areas. Topsoil shall be approved by the Engineer prior to placement, and unless otherwise directed, shall be material previously excavated and stockpiled for the purpose during excavating and grading operations. Grades on areas to receive topsoil shall be established and maintained as a part of the grading operations. Immediately prior to dumping and spreading topsoil, the surface shall be loosened by discing or scarifying to a depth of two inches (2") to permit bonding of the topsoil to the underlying surface.

The method of compaction and the equipment used shall be appropriate for the material to be compacted and shall not transmit damaging shocks to the pipe.

Backfill shall not be placed when material contains frost, is frozen, or a blanket of snow prevents proper compaction. Backfill shall not contain waste material, organic material, or debris of any kind.

Trench backfill above pipe embedment in locations other than those specified shall be compacted to 90% of the maximum density at optimum moisture content as determined by ASTM D698, unless otherwise permitted by the Engineer.

Pipe embedment material for compacted backfill shall comply with this chapter.

B. Job-Excavated. At the option of the Contractor, compacted backfill may be job-excavated material or graded gravel, except that all street crossings shall be backfilled with graded gravel, four feet (4') back of curb to four feet (4') back of curb. Job-excavated material may be used for compacted backfill when the job-excavated material is finely divided and free from debris, organic material, cinders, or other corrosive material, and stones larger than three inches (3") in greatest dimension. Large masses of moist, stiff clay shall not be used. Job-excavated material shall be compacted to 95percent of maximum density at optimum moisture content as determined by ASTM D698 when the test is appropriate, or to 70 percent relative density as determined by ASTM D4253 when that test is appropriate.

C. Uncompacted Earth. Uncompacted earth backfill material to be placed above embedment shall be free of brush, roots, more than two inches (2") in diameter, debris, cinders, or other corrosive material, and junk, but may contain rubble and detritus from rock excavation, stones, and boulders in certain portions of the trench depth. Uncompacted backfill material above embedment may be placed by any method acceptable to the Engineer which will not impose excessive concentrated or unbalanced loads, shock, or impact on and which will not result in displacement of installed pipe. Uncompacted backfill shall be placed to the extent necessary to prevent excessive future settlement.

Compact masses of stiff clay or other consolidated material more than 1 cubic foot in volume shall not be permitted to fall more than five feet (5') into the trench unless cushioned by at least two feet (2') of loose backfill above pipe embedment.

No uncompacted trench backfill material containing rocks, or rock excavation detritus, shall be placed in the upper 18 inches of the trench except with specific permission of the Engineer, nor shall any stone larger than eight inches (8") in its greatest dimension be placed within three feet (3') of the top of pipe. Large stones may be placed in the remainder of the trench backfill only if well separated and so arranged that no interference with backfill settlement will result.

3019-2. Structure Backfill. Backfill around structures shall be compacted to the extent necessary to prevent future settlement by tamping or other means acceptable to the Engineer.

Material for backfill shall be composed of earth only and shall contain no wood, grass, roots, broken concrete, stones, trash, or debris of any kind. No tamped or otherwise mechanically-compacted backfill shall be deposited or compacted in water.

No backfill shall be placed over or around any structure until the concrete or mortar therein has attained a minimum strength of 2000 psi and can sufficiently support the loads imposed by the backfill without damage.

The Contractor shall use utmost care to avoid any wedging action between the side of the excavation and structure that would cause any movement of the structure. Any damage caused by premature backfill or by the use of equipment on or near a structure is the responsibility of the Contractor.

Backfill shall be placed and compacted on all sides of the structure simultaneously, and operations shall be so conducted that the backfill is approximately the same elevation on all sides of the structure.

No excavated rock larger than four inches (4") maximum dimension shall be placed within one foot (1') of the exterior surface of any structure.

3019-3 Protection of Trench Backfill. Where trenches are constructed in ditches or other water courses, backfill shall be protected from surface erosion.

When the grade of the ditch exceeds 1 percent, ditch checks shall be installed. Unless otherwise shown on the drawings or directed by the Engineer, ditch checks shall be concrete. Ditch checks shall extend not less than two feet (2') below the original ditch or water course bottom for the full bottom width and at least 18 inches into the side slopes and shall be at least 12 inches thick.

3020 DENSITY TESTING. At the option of the Engineer, in-place field density testing to determine compliance with specified compaction requirements may be performed using a nuclear moisture-density measuring device. If, as a result of this field testing, the engineer determines that further compaction is required, the Contractor shall revise his compaction procedures to obtain the results specified.

3021 DRAINAGE MAINTENANCE. Trenches across roadways, driveways, walks, or other traffic ways adjacent to drainage ditches or water courses shall not be backfilled prior to completion of backfilling the trench on the upstream side of the traffic way, to prevent

impounding water after the pipe has been laid. Bridges and other temporary structures required to maintain traffic across such unfilled trenches shall be constructed and maintained by the Contractor. Backfilling shall be done so that water will not accumulate in unfilled or partially-filled trenches. All material deposited in roadway ditches or other water courses crossed by the line of trench shall be removed immediately after backfilling is completed and the original section, grades, and contours of ditches or water courses shall be restored. Surface drainage shall not be obstructed longer than necessary.

3022 DISPOSAL OF EXCESS EXCAVATED MATERIALS. Except as otherwise permitted, all excess excavated materials shall be disposed of away from the site or work. Broken concrete and other debris resulting from pavement or sidewalk removal, excavated rock in excess of the amount permitted to be and actually installed in trench backfill, junk, and debris encountered in excavation work and other similar waste materials shall be disposed of away from the site of the work.

Excess earth from excavation located in unimproved property shall be distributed directly over the pipe trench and within the pipeline right-of-way to a maximum depth of six inches (6") above the original ground surface elevation at and across the trench and sloping uniformly. Drag with blade machine, or other suitable tool to a smooth, uniform surface without obstructing drainage at any point. Wasting of excess excavated material in the above manner will not be permitted where the line of trench crosses or is within a railroad, public road, or highway right-of-way. The disposal of waste and excess excavated materials, including hauling, handling, grading, and surfacing shall be a subsidiary obligation of the contractor and no separate payment will be made therefore.

3023 SETTLEMENT. The Contractor shall be responsible for all settlement of backfill, fills and embankments which may occur within two (2) years of time after final acceptance of the contract under which the work was performed.

A suitable maintenance bond in an amount approved by the director of public works/engineering shall be furnished by the Contractor to the city guaranteeing the maintenance of the construction under which the contract was performed. Said bond shall remain in effect for the period mentioned above from the date of completion and acceptance of the work by the city.

The Contractor shall make, or cause to be made, all repairs or replacements made necessary by settlement within thirty (30) days after notice from the Engineer.

3024 PRESSURE SYSTEMS.

3024.1 Force Mains.

1. Pipe Material
2. Valves
    a. support
3. Anchoring
    a. Thrust Blocks

1. Identification
2. Corrosion

b. Receiving MH

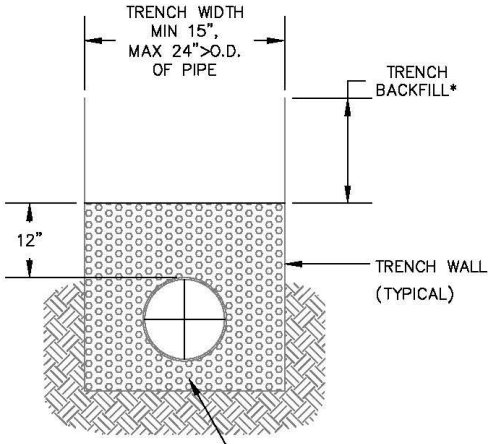
3024.2 Low pressure

1. Pipe material
2. Valves
   c. support

*TRENCH BACKFILL:

1. UNDER PAVED SURFACE
   - ¾" TO 1" CLEAN CRUSHED STONE FROM 4' BACK-OF-CURB TO 4' BACK-OF-CURB

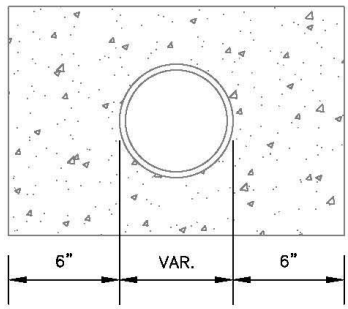
2. OUTSIDE PAVED SURFACE
   - WITHIN R/W
     JOB EXCAVATED MATERIAL COMPACTED TO 95% OF MAX. DENSITY.
   - OUTSIDE R/W
     JOB EXCAVATED MATERIAL COMPACTED TO 90% OF MAX. DENSITY.

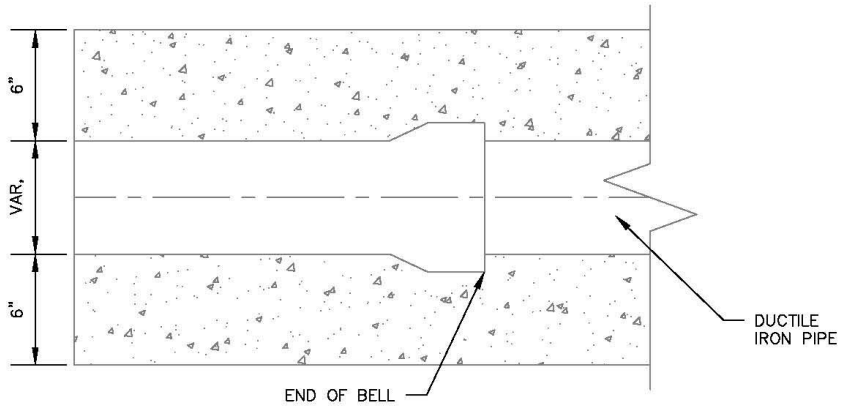



IN ROCK:
- 6" CLEAN CRUSHED STONE EMBEDMENT

IN EARTH:
- PVC TO HAVE 6" CLEAN CRUSHED ROCK EMBEDMENT

| | | |
|---|---|---|
| Branson MISSOURI ★ Engineering & Public Works | EMBEDMENT AND BACKFILL FOR SANITARY SEWERS | STANDARD DRAWING 30-1 |
| | | ADOPTED 2023 / REVISION |

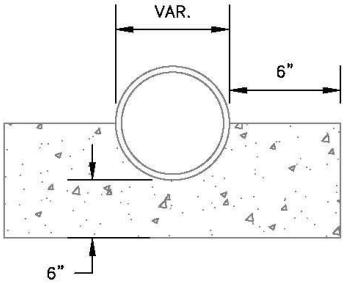


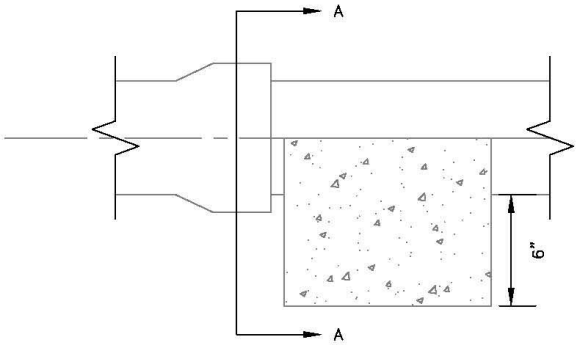

FOR USE ONLY WHERE INDICATED ON PLANS. THE CONCRETE ENCASEMENT SHALL BE OF 3,000 PSI CONCRETE WITH A MINIMUM THICKNESS OF 6" ON ALL SIDES.

1. 8" DIA. = .11 C.Y. OF CONCRETE PER LINEAL FT.
2. 10" DIA. = .12 C.Y. OF CONCRETE PER LINEAL FT.
3. 12" DIA. = .14 C.Y. OF CONCRETE PER LINEAL FT.
4. 15" DIA. = .15 C.Y. OF CONCRETE PER LINEAL FT.

| | | | |
|---|---|---|---|
| Branson MISSOURI Engineering & Public Works | CONCRETE ENCASEMENT DETAIL | STANDARD DRAWING 30-2 | |
| | | ADOPTED 2023 | REVISION |



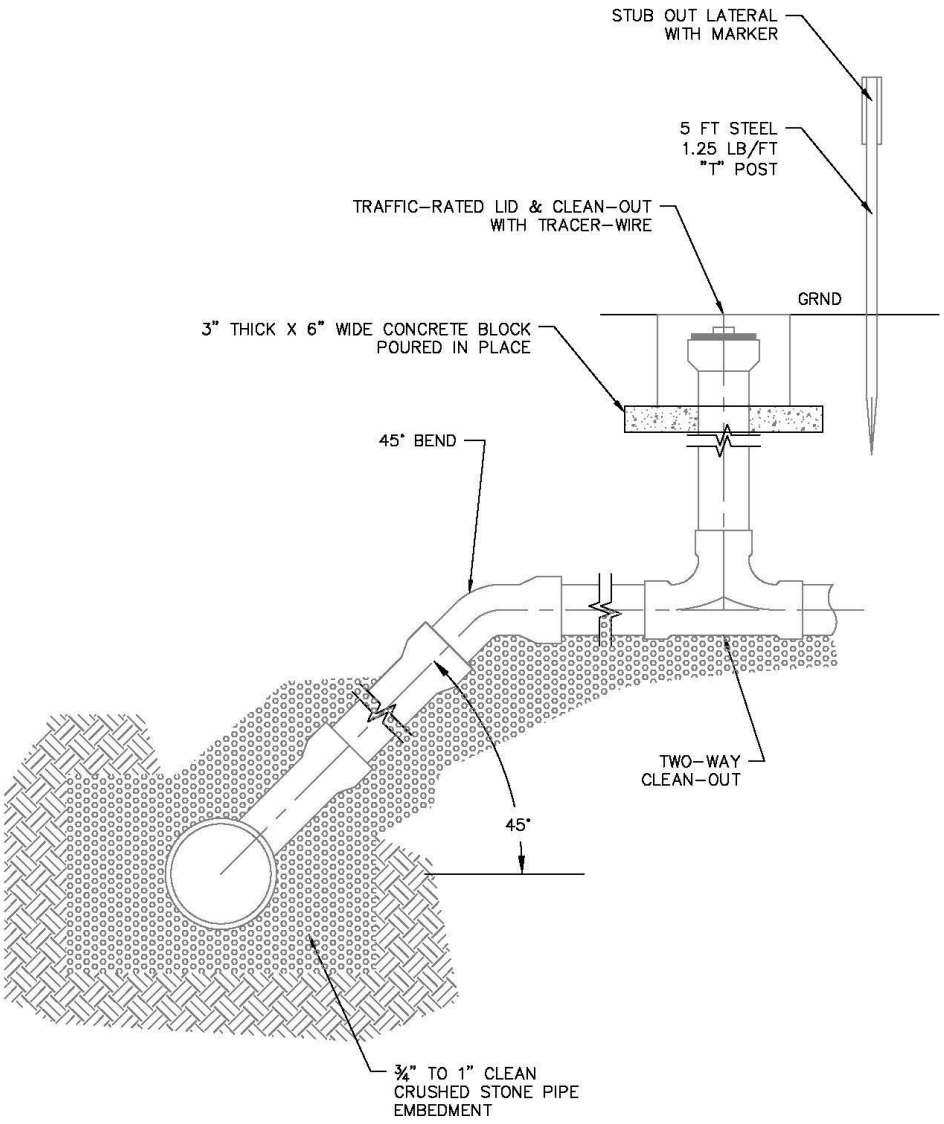

SECTION A-A




ELEVATION VIEW

FOR USE ONLY WHERE INDICATED ON PLANS. THE CONCRETE SHALL BE OF 3,000 PSI CONCRETE. THE MINIMUM THICKNESS ON THE SIDES AND BOTTOM SHALL BE 6". THE TOP OF THE CONCRETE SHALL BE AT LEAST TO THE CENTER OF THE PIPE.

| | | | |
|---|---|---|---|
| Branson MISSOURI ★ Engineering & Public Works | CONCRETE CRADLE DETAIL | STANDARD DRAWING 30-3 | |
| | | ADOPTED 2023 | REVISION |

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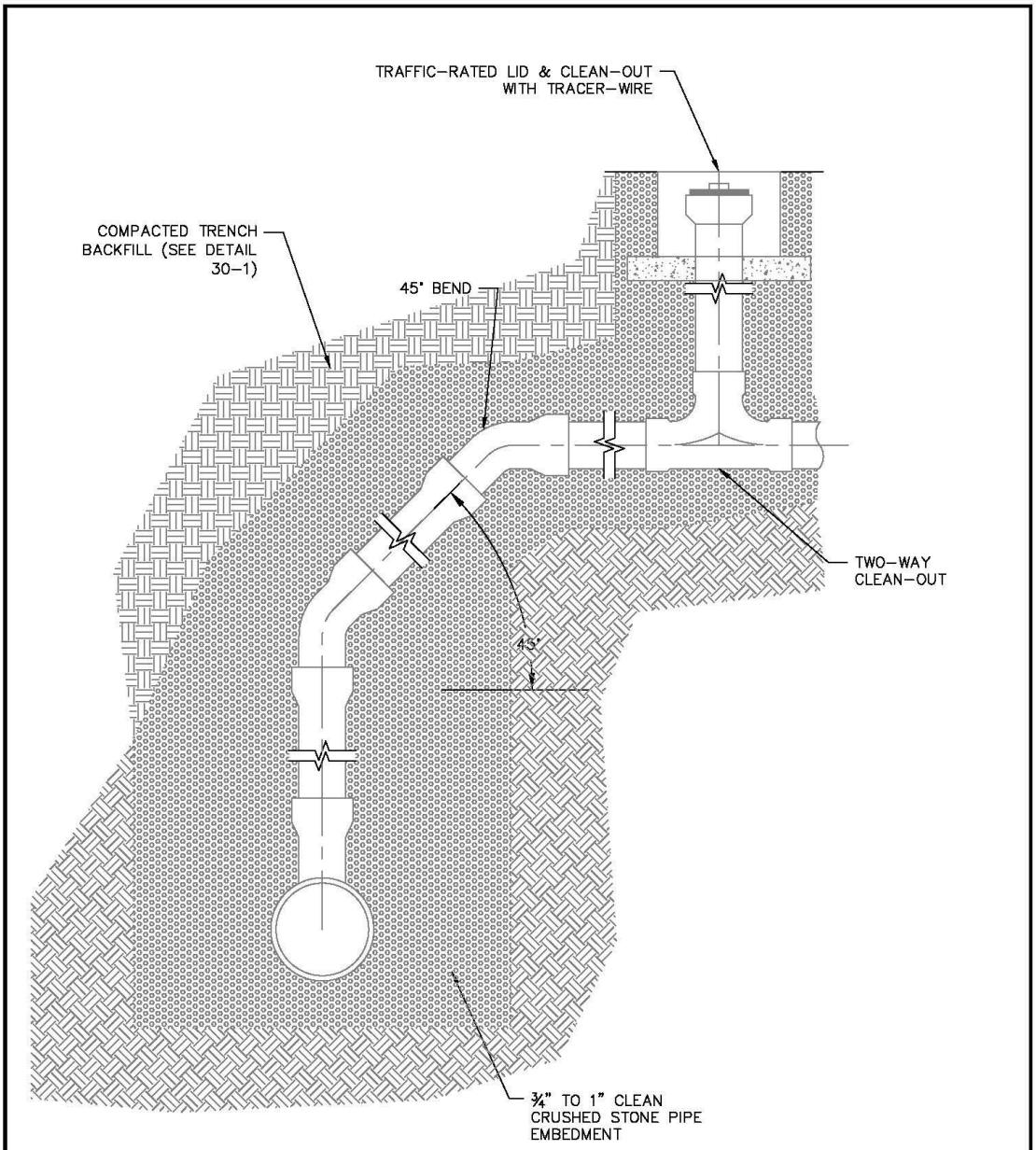
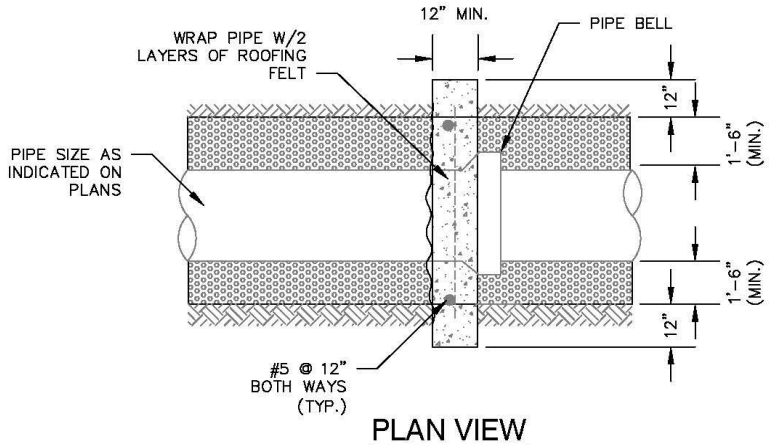
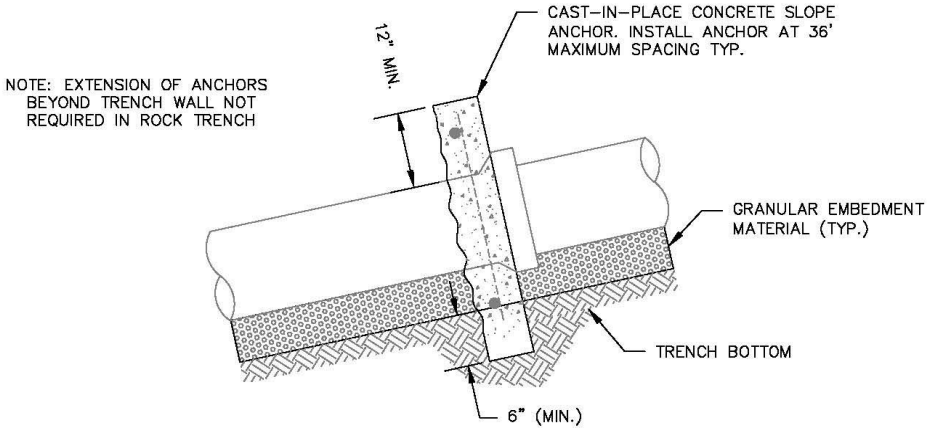
| Branson MISSOURI Engineering & Public Works | STANDARD DEEP TRENCH SERVICE RISER DETAIL | STANDARD DRAWING 30-4 | |
| | | ADOPTED 2023 | REVISION |




| | | | |
|---|---|---|---|
| Branson MISSOURI Engineering & Public Works | STANDARD DEEP TRENCH SERVICE RISER (IN ROCK) DETAIL | STANDARD DRAWING 30-5 | |
| | | ADOPTED 2023 | REVISION |




PLAN VIEW




ELEVATION VIEW

| | | | |
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| Branson MISSOURI Engineering & Public Works | SLOPE ANCHOR DETAIL | STANDARD DRAWING 30-6 | |
| | | ADOPTED 2023 | REVISION |

SECTION 3100 MANHOLE AND SPECIAL STRUCTURES - SANITARY SEWERS

3101 SCOPE. This section governs the furnishing of all labor, equipment, tools, and materials, and the performance of all work incidental to the construction of manholes, drop manholes and special sewer structures complete with covers, steps, fittings and appurtenances as required for sanitary sewer construction.

3102 GENERAL. As used herein special structures refers to manholes on large sewers, special junction structures, metering stations, siphons and similar structures constructed on the pipeline.

Manholes and special structures may be constructed of precast concrete sections or cast-in-place concrete. Construction of brick masonry is not allowed.

3103 CONSTRUCTION.

C. General. Manholes and special structures shall be constructed at locations indicated and in accordance with details as shown on the plans or Standard Detail Drawings. Manholes will be constructed with eccentric cones unless otherwise approved by the director of public works/engineering.

D. Precast Wall and Reducing Cone Sections. Handle with care to avoid damage to joint ends of each section. Damaged sections may be subject to rejection at the city's discretion.

When using an O-ring joint care shall be exercised in placing the O-ring on the spigot end, and lowering the bell section on the spigot end to obtain a watertight seal.

When using bitumastic joints, both spigot and bell end shall be primed with solvent material compatible to the adhesive in the mastic. Approved bitumastic material shall completely fill the joints so that a minimum of 1/4-inch bead of material is visible after jointing, to be smoothed off after completion of the jointing operation.

When a flexible preformed butyl rubber or bituminous polymer compounded with modifiers is used to seal jointed sections of manholes, the extrusion of sealant from the joint is not required. The vertical spacing between manhole sections shall not exceed 1/4-inch. Preformed joint sealers shall remain flexible at temperatures as low as 0 degrees Fahrenheit.

All bitumastic materials or preformed flexible joint sealants shall not be applied to wet or damp surfaces.

E. Cast-in-Place. Consolidate concrete with mechanical vibrators to eliminate entrapped air voids and rock pockets. Forms shall be supported in such a manner as to prevent any movement of the forms while concrete is being cured. Any movement of the forms may be cause for rejection.

D. Invert Channels. Alignment of the invert channels shall be as shown on the approved drawings. When no specific details and dimensions are given, changes in flow direction shall

be smooth, uniform and made with the longest radius possible. The cross sectional shape of invert channels shall match the lower halves of the entering and existing pipes. The surfaces of the channels shall be steel-troweled to produce a dense, smooth surface.

3104 MANHOLE CONNECTIONS. All new sewer line construction shall use flexible gaskets to provide a watertight connection such as the "A-LOK" brand product. Because of the A-LOK connector's (or equivalent) ability to insure a flexible, watertight joint, NO mortar shall be placed around the connector on the outside of the structure and NO mortar shall be placed around the top half of the connector on the inside when completing the invert work. The use of mortar in either of these areas would eliminate the flexibility for which the connector is designed, and cause problems of shear. For all outlet transitions, mortar only the bottom half of the pipe to complete a smooth transition into the pipe. The mortar shall be "Quadex Quad-Plug" with compressive strength meeting ASTM C109 and bond strength meeting ASTM C321 or approved equal.

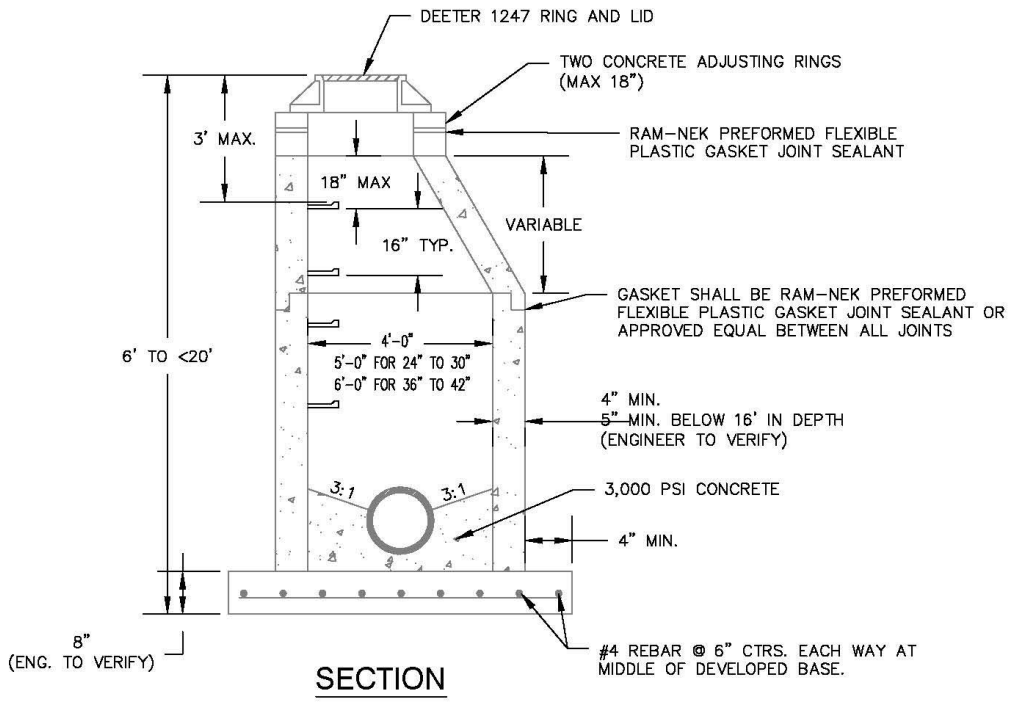
A. Inside Drop.

B. Outside Drop.

3105 CURING. All cast-in-place concrete shall be adequately protected from freezing and loss of moisture for the first 24 hours. The curing methods and materials to be used shall be approved by the Engineer.

3106 MANHOLE RINGS. The use of manhole rings shall be limited and their use will be reviewed by the city on a case-by-case basis. All rings for manhole covers shall be set to match elevations indicated on the city approved plans. Each ring shall be set on one four- inch (4") and one six-inch (6") adjusting ring as indicated on the Standard Detail Drawings. Mastic sealant shall be provided between all joints.

3107 WATER-PROOFING. Two coats of an asphalt or coal-tar pitch waterproof coating shall be applied to the exterior of all manhole structures from base to manhole ring. The coating shall be applied in sufficient quantity so that no bare or thin spots show. The coating shall be applied in sufficient time to permit proper curing prior to backfilling the excavation. Proper methods and material shall be used during backfilling to prevent damage to the coating. Any damage to the coating which does occur shall be immediately repaired.

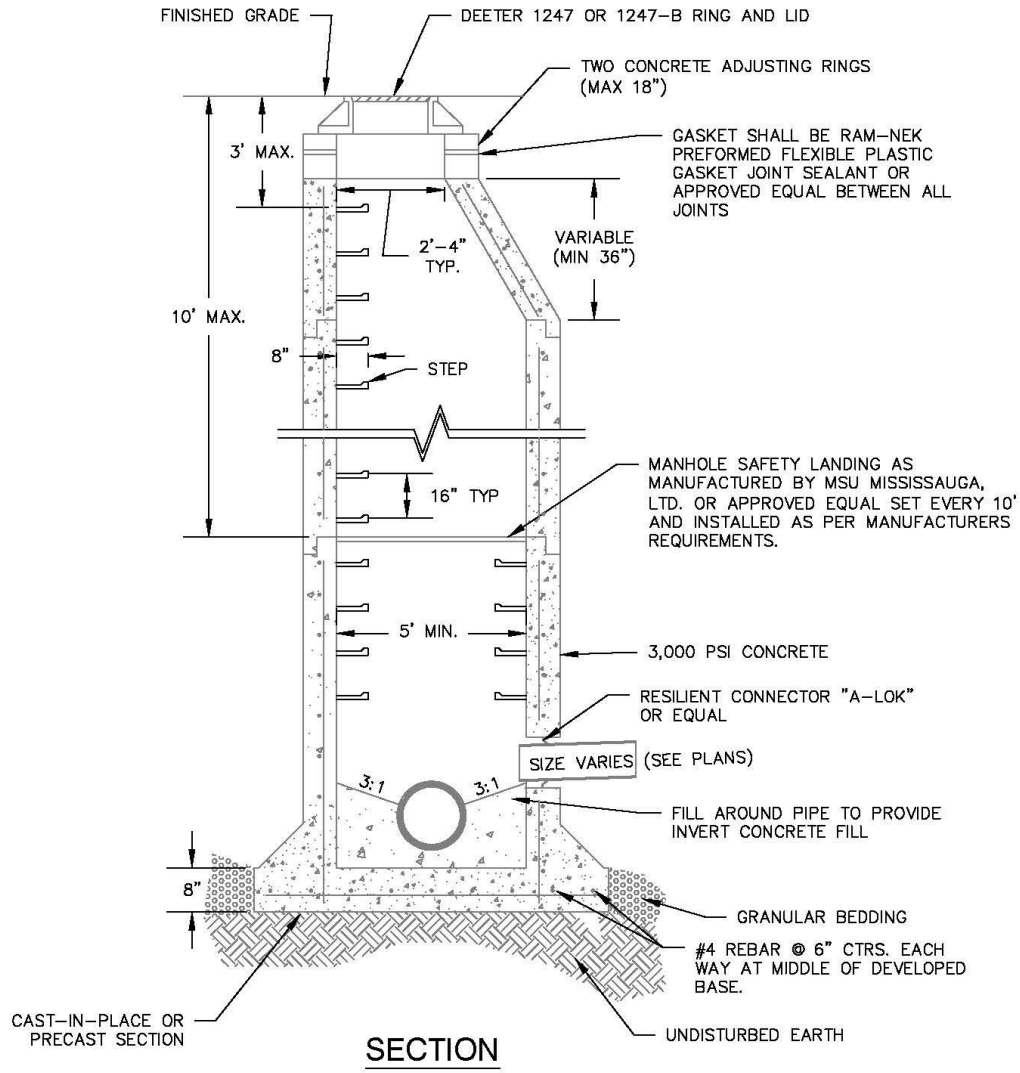



SECTION

NOTES:

1. PRECAST CONCRETE MANHOLES SHALL CONFORM TO ASTM C478 EXCEPT AS MODIFIED BY THE SPECIFICATIONS.
2. BASES NOT BUILT MONOLITHIC WITH BOTTOM SECTION SHALL BE POURED OF 3,000 PSI CONCRETE.
3. INSTALLATION OF JOINT SEALANT SHALL FOLLOW MANUFACTURER'S SPECIFICATIONS
4. THE BOTTOM SECTION OF ALL PRECAST MANHOLES NOT BUILT MONOLITHICALLY WITH THE BASE SHALL BE SET INTO A STEEL REINFORCED POURED CONCRETE BASE A MINIMUM OF 4' (#4 @ 6' E.W.)
5. WATERPROOFING WILL BE REQUIRED ON THE OUTSIDE OF MANHOLES. THE BITUMEN SHALL CONSIST OF TWO (2) EIGHT (8) MIL COATS OF ASPHALT, COAL-TAR PITCH, OR A COATING MEETING ASTM D41. ASPHALT SHALL CONFORM TO THE REQUIREMENTS OF ASTM D449. COAL-TAR PITCH SHALL CONFORM TO THE REQUIREMENT OF ASTM C450.
6. THE COMPRESSIVE STRENGTH OF CONCRETE USED IN THE CONSTRUCTION OF PRECAST REINFORCED CONCRETE MANHOLES SHALL NOT BE LESS THAN 4,000 PSI.
7. ONLY ECCENTRIC MANHOLE CONES WILL BE ALLOWED UNLESS OTHERWISE APPROVED BY THE CITY ENGINEER.
8. ADDITIONAL BASE THICKNESS FOR MANHOLES GREATER THAN 20' DEEP SHALL BE APPROVED BY CITY ENGINEER WITH SUBMITTAL OR APPROPRIATE CALCULATIONS.

| Branson MISSOURI Engineering & Public Works | STANDARD PRECAST MANHOLE DETAIL | STANDARD DRAWING 31-1 | |
|---|---|---|---|
| | | ADOPTED 2023 | REVISION |

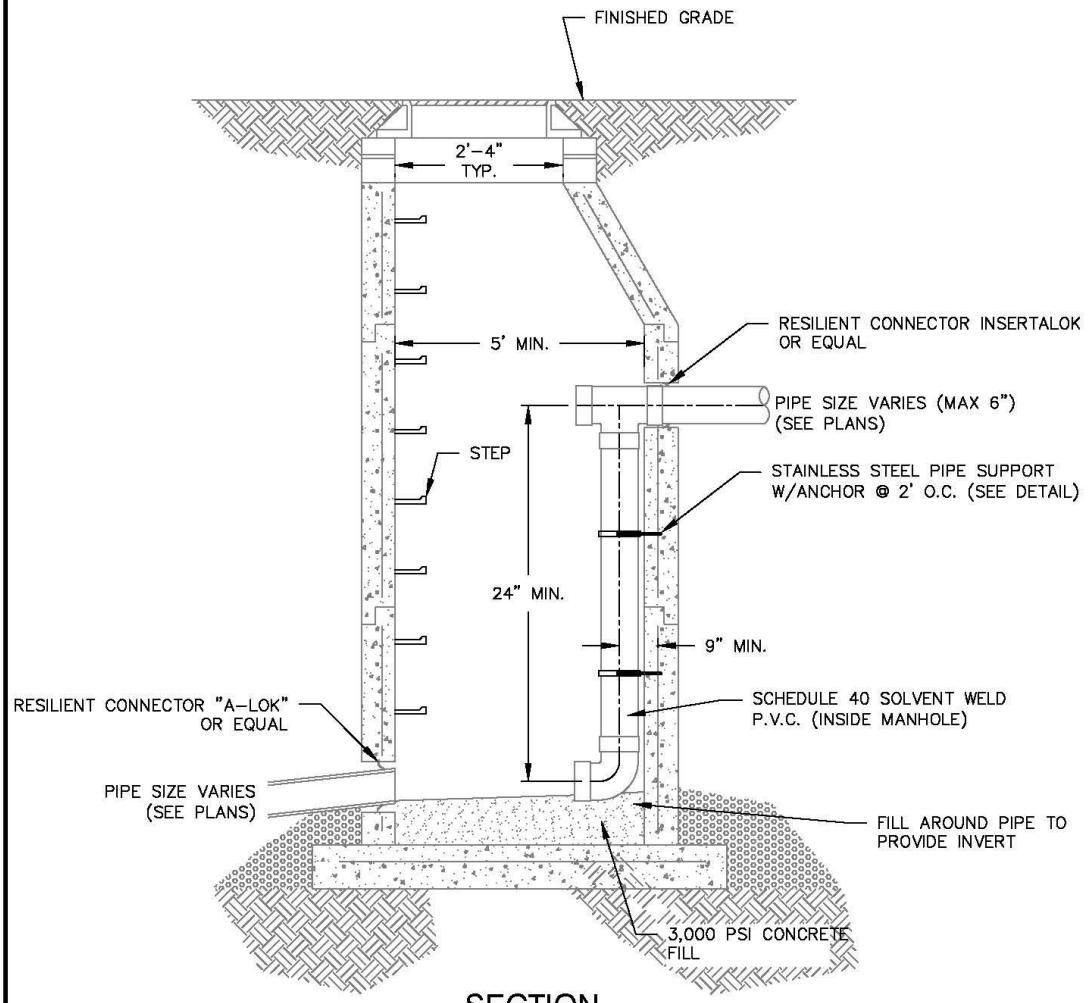



SECTION

*SEE NOTES ON STANDARD PRECAST MANHOLE DETAIL 31–1

| | | | |
|---|---|---|---|
| Branson MISSOURI ★ Engineering & Public Works | DETAIL FOR PRECAST MANHOLES DEEPER THAN 20' | STANDARD DRAWING 31-1A | |
| | | ADOPTED 2023 | REVISION |

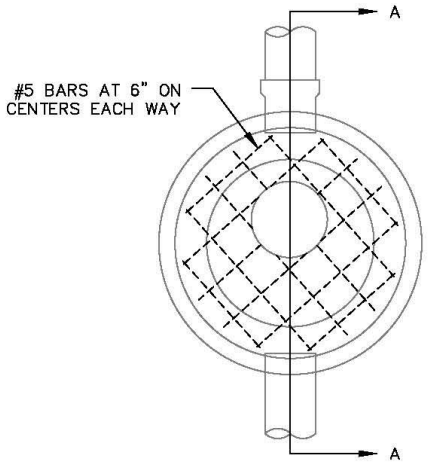
NOTE: DROP REQUIRED WHEN MANHOLE IS GREATER THAN 2 FT FROM INVERT




SECTION

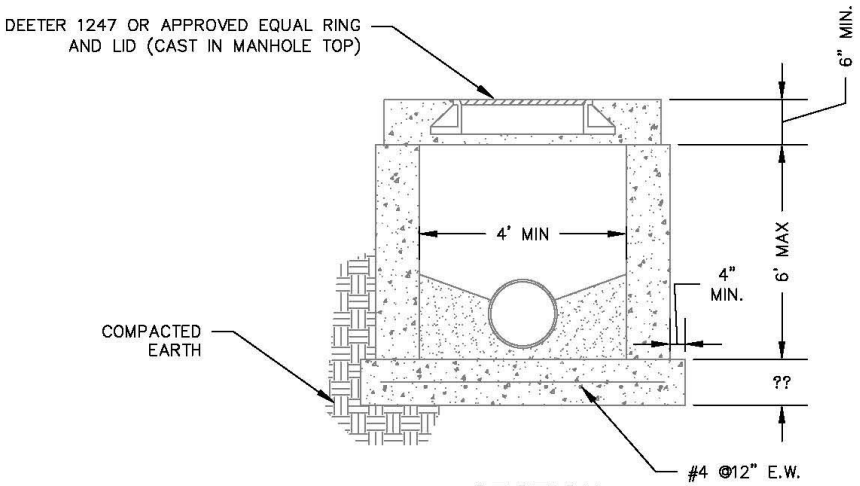
| | | | |
|---|---|---|---|
| Branson MISSOURI ★ Engineering & Public Works | STANDARD SERVICE LINE INSIDE DROP MANHOLE DETAIL | STANDARD DRAWING 31-2 | |
| | | ADOPTED 2023 | REVISION |

NOTE:
1. WATERPROOFING WILL BE REQUIRED ON THE OUTSIDE OF MANHOLES. THE BITUMEN SHALL CONSIST OF TWO (2)–EIGHT (8) MILL COATS OF ASPHALT, COAL TAR PITCH, OR A COATING MEETING ASTM D–41. ASPHALT SHALL CONFORM TO THE REQUIREMENTS OF ASTM D449. COAL–TAR PITCH SHALL CONFORM TO THE REQUREMENTS OF ASTM C 450.
2. FOR ALL DIMENSIONS NOT SHOWN, SEE PLANS



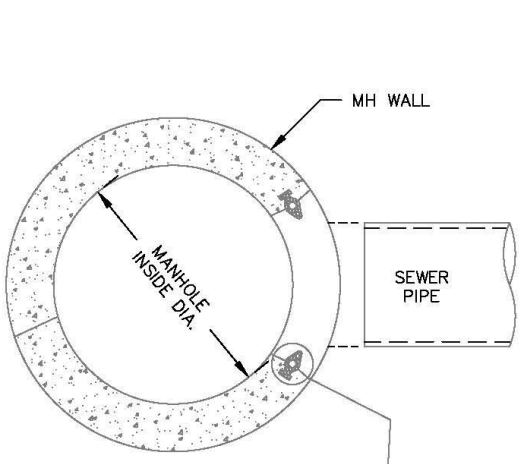

USE OF STANDARD LID AND RING WILL BE ALLOWED WHERE GRADE PERMITS (SEE SPEC. FOR APPROVED TYPES)

PLAN

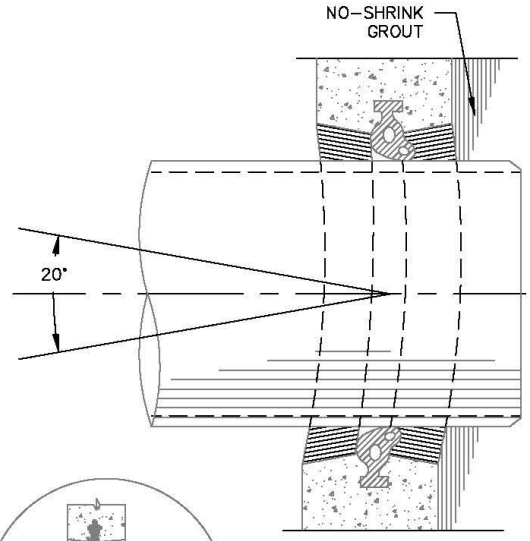



SECTION

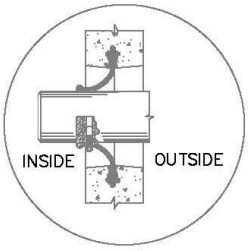
| | | | |
|---|---|---|---|
| Branson MISSOURI ★ Engineering & Public Works | STANDARD SHALLOW MANHOLE DETAIL | STANDARD DRAWING 31-3 | |
| | | ADOPTED 2023 | REVISION |




**CROSS SECTION**
OF A-LOK BEFORE INSTALLATION




**CROSS SECTION**
OF A-LOK AFTER INSTALLATION



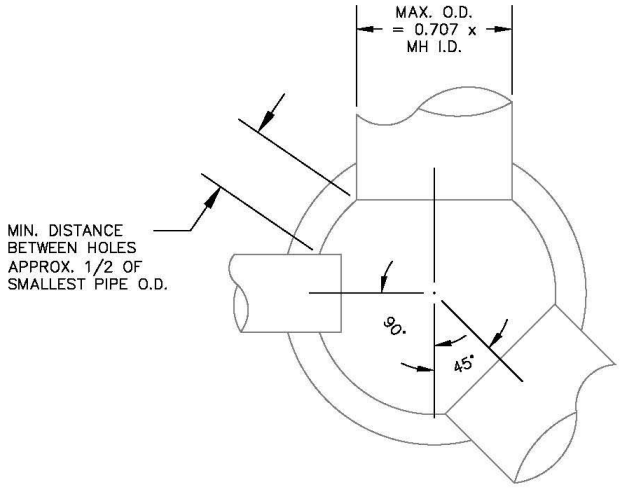

**CROSS SECTION**
OF Z-LOK AFTER INSTALLATION

NOTE: USE "Z"-LOK IF PIPE IS GREATER THAN 10 PERCENT SLOPE OR APPROVE EQUAL FOR PIPE CONNECTION TO MANHOLE.

THE A-LOK IS A HIGH PERFORMANCE FLEXIBLE CONNECTOR DESIGNED TO PRODUCE A POSITIVE WATERTIGHT CONNECTION FOR PIPES ENTERING PRECAST MANHOLES AND OTHER CONCRETE SURFACES. THE RUBBER CONNECTOR IS COMPOUNDED FROM A POLYISOPRENE BLEND WHOSE PERFORMANCE HAS BEEN PROVED TO BE EXCELLENT FOR USE IN SANITARY SYSTEMS.

INTEGRAL PLACEMENT OF THE CONNECTOR IN THE CONCRETE WALL IS ACHIEVED BY USE OF A TWO PART PRECISION MANDREL WITH A POSITIVE SECURING SYSTEM TO "LOCK IN" CONNECTORS ON THE CORRECT LINE AND GRADE.

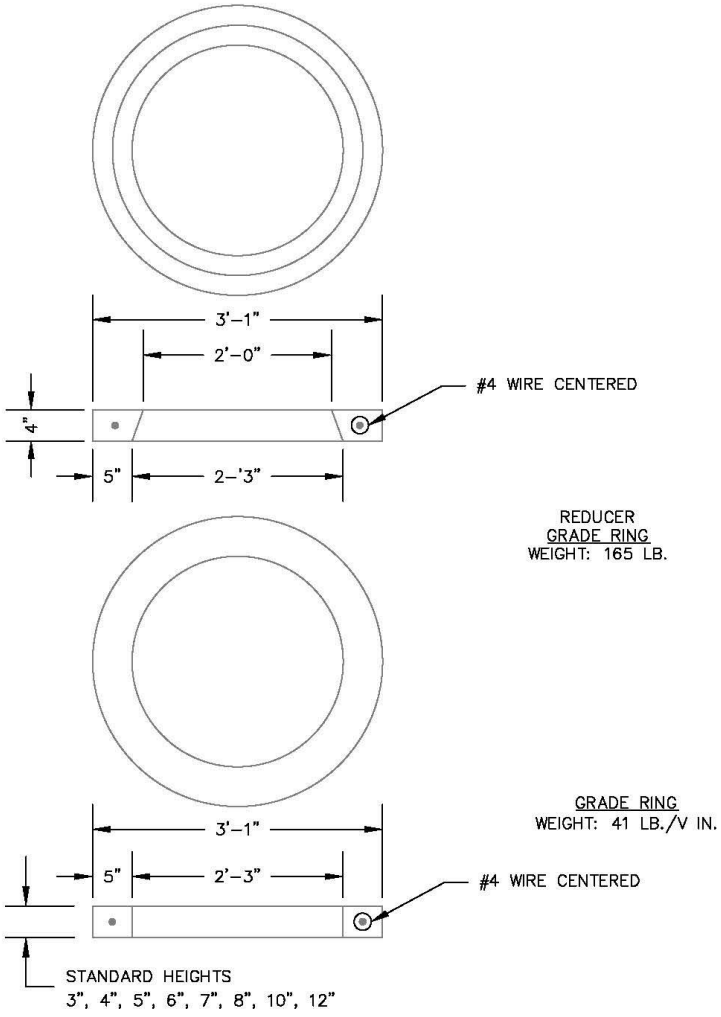
| | | | |
|---|---|---|---|
| Branson MISSOURI ★ Engineering & Public Works | MANHOLE CONNECTIONS W/ P.V.C. SEWER PIPE | STANDARD DRAWING 31-4 | |
| | | ADOPTED 2023 | REVISION |




## PLAN VIEW OF MANHOLE

| | MAX. PIPE SIZE O.D. | |
|---|---|---|
| MANHOLE DIA. | FROM STRAIGHT THRU TO 45° DEFL. | IF 90° DEFL. |
| 4 FT. | 31 1/2 IN | 25 IN |
| 5 FT. | 42 IN | 32 IN |
| 6 FT. | 51 IN | 38 IN |
| 7 FT. | 59 IN | 44 IN |
| 8 FT. | 73 1/2 IN | 50 IN |

| | | | |
|---|---|---|---|
| Branson MISSOURI Engineering & Public Works | MANHOLE CONNECTIONS W/ P.V.C. SEWER PIPE | STANDARD DRAWING 31-4A | |
| | | ADOPTED 2023 | REVISION |




GRADE RINGS SHALL MEET REQUIREMENTS OF ASTM C-478-80 STANDARD SPECIFICATION FOR PRECAST REINFORCED CONCRETE MANHOLE SECTIONS.

REINFORCEMENT: #4 WIRE, ASTM-82

CONCRETE: 4000 PSI

| | | |
|---|---|---|
| Branson MISSOURI Engineering & Public Works | GRADE RINGS | STANDARD DRAWING 31-5 |
| | | ADOPTED 2023 / REVISION |

SECTION 3200 ACCEPTANCE TESTS FOR SANITARY SEWERS

3201 SCOPE. This section governs the furnishing of all labor, equipment, tools and materials, and the performance of any or all acceptance tests as required by the Plans, Special Provisions, and these specifications.

3202 ACCEPTANCE TESTS FOR GRAVITY SEWERS.

A. Visual Inspection

1. Contractor shall clean pipe of excess mortar, joint sealant and other dirt and debris prior to inspection.

2. Correct defects as required prior to conducting leakage tests.

B. Leakage Tests. A leakage test shall be performed on the full length of all sewer lines prior to acceptance.

a. De-water pipe upon completion of testing.

C. Air Leakage Testing.

1. Contractor may perform air tests for all pipe sizes.

2. Furnish all facilities required including necessary piping connections, test pumping equipment, pressure gauges, bulkheads, regulator to avoid over pressurization, and all miscellaneous items required.

a. The pipe plug for introducing air to the sewer line shall be equipped with two taps. One tap will be used to introduce air into the line being tested, through suitable valves and fittings, so that the input air may be regulated. The second tap will be fitted with valve and fittings to accept a pressure test gauge indicating internal pressure in the sewer pipe. An additional valve and fitting will be incorporated on the tap used to check internal pressure so that a second test gauge may be attached to the internal pressure tap. The pressure test gauge will also be used to indicate loss of air pressure due to leaks in the sewer line.

b. The pressure test gauge shall meet the following minimum specifications:

| | |
|---|---|
| Size (diameter) | 4-1/2 inches |
| Pressure Range | 0-15 P.S.I. |
| Figure Intervals | 1 P.S.I. Increments |
| Minor Subdivisions | 0.05 P.S.I. |
| Pressure Tube | Bourdon Tube or Diaphragm |
| Accuracy | +- 0.25% of maximum scale reading |
| Dial | White coated aluminum with black lettering, |

| | |
|---|---|
| | 270 deg. Arc and mirror edge. |
| Pipe Connection | Low Male 1.2" N.P.T. |

Calibration data will be supplied with all pressure test gauges. Certification of pressure test gauge will be required from the gauge manufacturer. This certification and calibration data will be available to the Engineer whenever air tests are performed.

c. Test each reach of sewer pipe between manholes after completion of the installation of pipe and appurtenances and the backfill of sewer trench.

d. Plug ends of line and cap or plug all connections to withstand internal pressure. One of the plugs provided must have two taps for connecting equipment. After connecting air control equipment to the air hose, monitor air pressure so that internal pressure does not exceed 5.0 psig. After reaching 4.0 psig throttle the air supply to maintain between 4.0 and 3.5 psig for at least two (2) minutes in order to allow equilibrium between air temperature and pipe walls. During this time, check all plugs to detect any leakage. If plugs are found to leak, bleed off air, tighten plugs, and again begin supplying air. After temperature has stabilized, the pressured is allowed to decrease to 3.5 psig. At 3.5 psig, begin timing to determine the time required for pressure to drop from 3.5 psig to 2.5 psig. If the time, in seconds, for the air pressure to decrease from 3.5 psig to 2.5 psig is greater than that shown in the table below, the pipe shall be presumed free of defects.

| Pipe size | Required Time per 100 LF | Minimum Required Time |
|---|---|---|
| 8" | 70 sec | 227 sec |
| 10" | 110 sec | 283 sec |
| 12" | 158 sec | 340 sec |
| 15" | 248 sec | 425 sec |
| 18" | 356 sec | 510 sec |
| 21" | 485 sec | 595 sec |
| 24" | 634 sec | 680 sec |
| 27" | 765 sec | 765 sec |
| 30" | 851 sec | 851 sec |
| 33" | 935 sec | 935 sec |

Sanitary sewer mains with service stub lines shall be tested with a pressure at 5 psi for a duration of 15 minutes with no drop in test pressure.

If air test fails to meet above requirements, repeat test as necessary after all leaks and defects have been repaired. Prior to acceptance all constructed sewer lines shall satisfactorily pass the low pressure air test.

D. Deflection Tests. A deflection test shall be required on all installations involving flexible or semi-rigid pipe after said pipe has been laid and backfilled. *The tests shall be run not less than thirty (30) days after final backfill has been placed.* The maximum allowable deflection shall not exceed 5.0% of the pipe's internal diameter. The deflection test shall consist of guiding a devise of the appropriate size for the pipe involved to accurately measure any deflection in the pipe. The devise to be used shall be approved by the director of public works/engineering prior to its use. Attention is directed to the fact that the pipe's nominal diameter is greater than the actual internal diameter of the pipe. Lamping or other visual testing will not be approved as a substitution for deflection testing.

Upon completion of the testing, all piping showing a deflection greater than 5.0% shall be excavated, replaced, backfilled, and retested to the satisfaction of the Engineer.

## 3203 ACCEPTANCE TESTS FOR PRESSURE SEWAGE FORCE MAINS.

A. Perform hydrostatic pressure and leakage tests. Conform to AWWA C600 procedures as modified herein. Test shall apply to all pressure sewers. Perform after backfilling.

B. Test separately in segments between sectionalizing valves, between a sectionalizing valve and a test plug, or between test plugs. Select test segments such that adjustable seated valves are isolated for individual checking. Contractor shall furnish and install test plugs at no additional cost to the Owner, including all anchors, braces, and other devices to withstand hydrostatic pressure on plugs. Contractor shall be responsible for any damage to public or private property caused by failure of plugs. Limit fill rate of line to available venting capacity.

Conduct test at a pressure of 150 psi measured at the highest point of the main. Duration of the test shall not be less than two (2) hours with no loss in pressure.

1 All joints shall be watertight and free from leaks.

## 3204 ACCEPTANCE TESTS FOR SANITARY SEWER MANHOLES.

Test all manholes after completion but prior to backfilling of structure. Interior of manhole shall be dry with no standing water. All pipes entering and exiting the manhole shall be adequately plugged for the purposes of the vacuum testing. A vacuum of 10-inch Hg shall be drawn and the time recorded for the vacuum to drop to 9inch Hg. The time to drop shall meet or exceed the values as follows:

A. 48” Manhole Diameter: Up to 10 feet depth – 60 seconds, 10-15 feet depth – 75 seconds, 15-25 feet depth – 90 seconds

B. 60” Manhole Diameter: Up to 10 feet depth – 75 seconds, 10-15 feet depth – 90 seconds, 15-25 feet depth – 105 seconds

If the test fails or the manhole joint mastic or gasket is displaced, the manhole structure shall be repaired and re-tested. Interior repairs are not acceptable. The manhole shall be repaired on the exterior or be removed and replaced.

SECTION 4000 MATERIALS AND CONSTRUCTION - STORM SEWERS

4001 SCOPE. Storm sewer construction shall consist of furnishing all labor, materials, and equipment necessary for the complete installation of storm sewers and appurtenances. Unless otherwise noted within these specifications, the word "sewers" shall refer to pipe sewers, or open channels.

4002 SPECIFICATION MODIFICATION. It is understood that throughout this section these specifications may be modified or deleted by appropriate items in the Special Provisions or notes on the contract drawings.

4003 REVISIONS OF STANDARDS. When reference is made to a standard specification (ASTM, AWWA, MCIB, etc.), the specification referred to shall be understood to mean the latest revision of said specification as amended at the time of the Notice to Bidders, except as noted on the contract drawings or as provided for in the Special Provisions.

4004 MATERIALS.

A. Reinforced Concrete Pipe:

1. Pipe. Reinforced concrete pipe shall conform to the following ASTM Standards and be of the minimum strength designated herein or such higher strength as may be required by the Plans or Special Provisions:

   a. Round Pipe: ASTM C-76, Class III, Wall B.

   b. Elliptical Pipe: ASTM C-507, Class HE-III.

   c. Arch Culvert Pipe: ASTM C-506, Class A-III.

   Except for fittings and closure pieces, each joint of pipe shall not be less than eight feet long for pipe diameters 48 inches or less and shall not be less than six feet long for pipe diameters larger than 48 inches.

2. Reinforcement: Circumferential reinforcement shall be full-circle type. Part-circle reinforcement will not be approved. All reinforcing shall be located and spaced as recommended by the pipe manufacturer.

3. Joints:

   a. FRubber Gasket Joints: Rubber gasket joints shall conform to ASTM C 443 or ASTM C 1628-06 with the following additions and exceptions.

      ii. Replace ASTM C 1628-06 5.1.1 with: Circular Cross-Section or “O-

Ring" Gaskets for standard use shall meet Class A requirements. Non-Circular Cross-Section or "Profile" Gaskets for standard use shall meet Class E requirements

iii. Replace ASTM C 1628-06 9.4 with: The manufacturer shall conduct concurrently the hydrostatic test described in 9.2 and the structural test described in 9.3. If proven watertight under these combined conditions, hairline cracks that do not leak shall not be cause for rejection. A vacuum of the American Concrete Pipe Association, may be used in lieu of the hydrostatic test referenced above.

iv. Joint design details shall be submitted for approval together with design data and test results verifying the adequacy of the joint design.

b. Preformed Flexible Joint Sealant: This sealant shall be either rope form or flat tape form conforming to ASTM C 990. Primer, if recommended by the manufacturer, shall be applied within the manufacturers' time requirements on all bell and spigot joint surfaces. Joint shall be thoroughly sealed and watertight.

B. Corrugated Steel Pipe (CMP): Pipe, coupling bands and end section shall conform to the following requirements AASHTO M-36. Bituminous and/or other coatings shall be provided when required by the Special Provisions. Bituminous coating shall conform to AASHTO M-190. Minimum thickness of the metal after galvanizing shall be as follows:

1. Material
   a. Aluminized Steel Type 2 — AASHTO M274, ASTM A 929
   b. Polymer-Coated Steel — AASHTO M246, ASTM A 742
   c. Aluminum Alloy — AASHTO M 197, ASTM B 744

2. Pipe
   a. Steel (A;I,omozed Steel. Type 2, CSP and Spiral RIb) AASHTO M36, ASTM A 760
   b. Steel (Polymer-Cated, GSP, Spiral Rib, Smooth Interior CSP) AASHTO M36, AASHTO M245, ASTM A 745
   c. Aluminum (CMP, Spiral RIb) AASHTO M196, ASTM A 788

Minimum wall thickness of the pipe shall be as follows:

| **Circular Culvert Pipe** (2-2/3" x 1/2" corrugations) |
|---|

| **Under Roadways or In Street Right-of-Ways** | | **Under Railroads** | | **Not Under Roadways** | |
|---|---|---|---|---|---|
| **Diameter** | **Minimum Thickness** | **Diameter** | **Minimum Thickness** | **Diameter** | **Minimum Thickness** |
| 12”-21” | .064” | 12”-18” | .079” | 12”-30” | .064” |
| 24”-30” | .079” | 21”-24” | .109” | 36”-54” | .079” |
| 36”-54” | .109” | 30”-36” | .138” | 60”-84” | .109” |
| 60”-72” | .138” | 42”-84” | .168” | | |
| 84” | .168” | | | | |

| **Circular Culvert Pipe**<br>(3" x 1" and 5” x 1” corrugations) | | | |
|---|---|---|---|
| **Under Roadways or In Street Right-of-Ways** | | **Not Under Roadways** | |
| **Diameter** | **Minimum Thickness** | **Diameter** | **Minimum Thickness** |
| 36”-54” | .079” | 36”-54” | .064” |
| 60”-84” | .109” | 60”-84” | .079” |

| **Circular Culvert Pipe**<br>(3/4" x 3/4" x 7-½" Spiral Rib) | | | |
|---|---|---|---|
| **Under Roadways or In Street Right-of-Ways** | | **Not Under Roadways** | |
| **Diameter** | **Minimum Thickness** | **Diameter** | **Minimum Thickness** |
| 12”-24” | .064” | 12”-42” | .064” |
| 30”-42” | .079” | 48”-60” | .079” |
| 48”-66” | .109” | 66”-84” | .109” |
| 72”-84” | .138” | | |

| **Arch Culvert Pipe**<br>(2-2/3" x 1/2" Corrugations) | | | |
|---|---|---|---|
| **Under Roadways or In Street Right-of-Ways** | | **Not Under Roadways** | |
| **Equivalent Diameter** | **Minimum Thickness** | **Span*** | **Rise*** |
| 15” | .064” | 117” | 13” |
| 18” | .064” | 321” | .15” |
| 21” | .064” | 624” | 18” |
| 24” | .079” | 28” | 20” |
| 30” | .079” | 35” | 24” |
| 36” | ..109” | 42” | 29” |
| 42” | .109” | 49” | 33” |
| 48” | .109” | 57” | 38” |
| 54” | .109” | 64” | 43” |
| 60” | .138” | 71” | 47” |

| **Arch Culvert Pipe**<br>(3" x 1" Corrugations) | | | |
|---|---|---|---|
| **Equivalent Diameter** | **Minimum Thickness** | **Span*** | **Rise*** |
| 36” | .064” | 40” | 31” |
| 42” | .064” | 46” | 36” |
| 48” | .064” | 53” | 41” |
| 54” | .079” | 60” | 46” |
| 60” | .079” | 66” | 51” |
| 66” | .079” | 73” | 55” |
| 72” | .079” | 81” | 59” |
| 78” | .109” | 87” | 63” |
| 84” | .109” | 95” | 67” |
| 90” | .109” | 103” | 71” |

| **Arch Culvert Pipe** (3/4" x 3/4" x 7-1/2" Spiral Rib) | | | |
|---|---|---|---|
| **Equivalent Diameter** | **Minimum Thickness** | **Span*** | **Rise*** |
| 18" | .064" | 20" | 31" |
| 21" | .064" | 23" | 36" |
| 24" | .064" | 27" | 41" |
| 30" | .079" | 33" | 46" |
| 36" | .079" | 40" | 51" |
| 42" | .079" | 46" | 55" |
| 48" | .109" | 53" | 59" |
| 54" | .109" | 60" | 63" |
| 60" | .109" | 66" | 67" |
| 66" | .109" | 73" | 71" |

*Subject to manufacturing tolerances.

3. Joints: Joints shall have a gasket and may be either bell and spigot joints or made with external coupling bands. The bands shall be drawn and secured on the pipe by connecting devices as furnished by the manufacturer. Pipe ends for annular corrugation shall be identical to the rest of the pipe barrel (plain ends), or in the case of helical pipe, the pipe ends at the joint shall be reformed to an annular corrugation and flange (reformed end). Gaskets shall be furnished in accordance with the Plans and Special Provisions. Coupling bands shall be reviewed and approved by the Engineer prior to installation.

a. Structural Plate Pipe and Pipe Arches. Structural plate and galvanizing shall conform to the requirements of ASTM A 761. Bolts, nuts, and washers for reconnecting plates shall be galvanized in accordance with ASTM A 153 and meet manufacturer's recommendations.

b. High Density Polyethylene (HDPE) Pipe.

1. Materials: Pipe manufactured for this specification shall comply with and be certified to meet the requirements for test methods, dimensions and markings found in ASTM F 2306 and AASHTO M-294, current additions. Pipe and blow molded fittings shall be made from PE compounds which conform to the requirements of cell class 435400C in the latest version of ASTM D3350.

2. Pipe Sizes: Nominal sized for this specification include 12-60 inch diameters designated in AASHTO M 294 and ASTMN F 2306 as full circular cross section with an outer corrugated pipe wall and essentially smooth inner wall (waterway). Pipe corrugating shall be annular.

3. Joints: Joints shall have a gasket and may be either bell and spigot joints or made

with external coupling bands. The fittings and couplings bands shall be fabricated from the same material as the pipe conforming to AASHTO M294. The coupling bands shall cover at least two full corrugations of each section of pipe and shall prevent infiltration of soil into the pipe. Gaskets shall be furnished in accordance with the Plans and Special Provisions. Coupling bands shall be reviewed and approved by the Engineer prior to installation.

4. Certification: All high-density polyethylene (HDPE) pipe used for culvert and storm sewer applications shall conform to the requirements of AASHTO M294 and ASTM F 2306, current edition. Pipe shall be provided only by manufacturers that are certified through the National Transportation Product Evaluation Program (NTPEP) Third Party Certification program.

5. Pipe Usage: High density polyethylene pipe (HDPE) may not be used for crossroad applications of collector roadways or higher unless approved by the Engineer. If approved by the Engineer, HDPE in accordance with ASTM F2648, latest version, may be used in lieu of ASTM F2306 and AASHTO M294 in drainage applications that are designated as private.

E. Dual Walled Polypropylene Pipe

1. For 12-inch to 60-inch pipe, polypropylene pipe shall have a double wall with a smooth interior and annular exterior corrugations and conform to ASTM F2881 and AASHTO M330. The pipe shall not be perforated unless otherwise specified.

2. For 12-inch to 60-inch pipe, pipe shall be joined with a gasketed integral bell and spigot joint meeting the requirements of ASTM F2881.

3. Coupling bands shall cover at least two full corrugations on each section of pipe and shall prevent the infiltration of soil into the pipe.

4. Certification: All polypropylene (PP) pipe used for culvert and storm sewer applications shall be provided only by manufacturers that are certified through the National Transportation Product Evaluation Program (NTPEP) Third Party Certification program.

F. Dual and Triple Walled Polypropylene Pipe

1. For 12-inch to 30-inch pipe, polypropylene pipe shall have a double wall with a smooth interior and annular exterior corrugations and conform to ASTM F2881 and AASHTO M330 Type S. For 36-inch and larger pipe sizes, polypropylene pipe shall have a triple wall with smooth interior and exterior surfaces with inner corrugations and conform to ASTM F 2764 and AASHTO M330 Type D. The pipe shall not be perforated unless otherwise specified.

2. For 12-inch to 30-inch pipe, pipe shall be joined with a gasketed integral bell and spigot joint meeting the requirements of ASTM F2881. For 36-inch and larger pipe, pipe shall be joined with a gasketed integral bell and spigot joint meeting the requirements of ASTM F2764.

3. Coupling bands shall cover at least two full corrugations on each section of pipe and shall prevent the infiltration of soil into the pipe.

4. Certification: All polypropylene (PP) pipe used for culvert and storm sewer applications shall be provided only by manufacturers that are certified through the National Transportation Product Evaluation Program (NTPEP) Third Party Certification program.

G. Granular Bedding Material: Refer to Section 1000 Site Preparation

H. Flow able Backfill (CLSM): Refer to Section 1000 Site Preparation

## 4005 CONSTRUCTION DETAILS.

A. Trench Excavation: Trenches shall be excavated to the width and depth as necessary to lay the pipe to the grade line as indicated on the Plans with proper pipe embedment. The Contractor shall perform excavation of materials encountered regardless of material type, to the depths indicated on the drawings or as otherwise specified herein. Excavated materials are to be deposited beside trenches and excavations to avoid overloading, and to prevent slides or cave-ins, transported to the spoil banks, or used for backfilling. All excavated materials not required or not suitable for backfill shall be removed and disposed of off the site by the Contractor as part of the Work. The trench excavation opened at one time shall be limited by the nature of the soil and other safety considerations.

All pipeline excavation work shall be accomplished under the supervision of a person employed by the Contractor or his subcontractor and experienced with the materials and procedures which will provide protection to existing improvements, including utilities and the proposed pipeline.

The alignment, depth, and pipe subgrades of all trenches shall be determined by a laser beam parallel to the pipe invert.

Deviation from the indicated alignment will not be permitted except under special circumstances, subject to approval of the Engineer.

Trenches that are parallel to structures, pavements or walls shall be no closer than 18 inches from the closest edge of footings or pavement. Also, no parallel trench shall extend in depth below a plane having a downward slope of 1 horizontal to 2 vertical starting from a line 9 inches above the bottom edge of footings or pavement. The bottom of pavement shall be

the lowest improved section of pavement to include chemically stabilized subgrade or aggregate base layers.

When pipe is to be installed in embankment or fill, the embankment shall be constructed in accordance with Section 1106 and shall be built up to a plane at least 18 inches above the top of the pipe prior to the excavation of the pipe trench.

The Contractor shall not open more trench in advance of pipe laying than is necessary. Four hundred (400) feet will be the maximum length of open trench allowed on any line under construction. All open trenches shall be adequately protected.

Undercutting of trench walls is not permitted.

Option to Trenching: Contractor may perform excavation by tunneling methods as set forth herein at no additional cost to the Owner provided prior written approval for each such location is obtained from the Engineer. The Contractor shall submit to the Engineer, prior to actual work, a written description of his proposed operation. It shall include the types and locations of shafts, methods to provide safe support strength for the pipeline when the shafts or bore pits exceed maximum allowable trench widths and other features that would affect the pipeline. Tunneling shall be done with a minimum inconvenience and disturbance to the

1. Unclassified Excavation. Unclassified excavation is defined as the removal of all material encountered regardless of its nature. All material excavated will be considered as Unclassified Excavation unless the Special Provisions specify Classified Materials.

2. Rock Excavation. Rock excavation is defined as the removal of all rock ledges six inches (6") or more in thickness, and detached rock or boulders having a volume of more than 1-1/2 cubic yards and shale occurring in its natural state, hard and unweathered.

   A rock ledge is defined as a continuous body of rock, which may include interbedded seams of shale or other soft materials less than 12 inches thick. The vertical limit of each ledge shall be defined by interbedded seems of soft materials 12 inches or more in thickness. The beds of soft interbedded material 12 inches or more in thickness shall not be included in the measurement for "Rock Excavation" but shall be included in the measurement for "Earth Excavation"

   The following items shall not be considered as rock excavation: soft or disintegrated rock or flowable backfill which can be removed with a pick or digging machine: loose, shaken or previously blasted rock; broken stones and rock which may fall into the trench from outside the limits of excavation.

   When solid rock is (including non-diggable flowable backfill (CLSM) is unexpectedly discovered, the Contractor shall notify the Owner.

3. Earth Excavation. Earth excavation is defined as the removal of all material not defined as rock.

4. De-watering. The Contractor shall remove any water which may accumulate, or be found in the trenches and other excavations made under the Contract. The Contractor shall form all dams, flumes or other works necessary to keep them clear of water while the sewers and their foundation, and other foundations works, are being constructed. All water shall be removed from such excavation in a manner to not damage property.

5. Cribbing and Sheeting. The Contractor shall furnish, install, and maintain such sheeting, bracing, etc., as may be required to support any excavation and to prevent any movement which could in any way injure or delay the work or endanger adjacent pavement, building or other structures. Care shall be taken to prevent voids outside of the sheeting, but if voids are formed they shall be immediately filled and consolidated.

   For the purpose of preventing injury or property damage, contractor may leave in place all sheeting or bracing, etc., to be embedded in the backfill of the trench. No sheeting or bracing, however, shall be left in place within five feet (5') of the surface without the written permission of the Engineer.
   Whenever timber or other sheeting is driven to a depth below the elevation of the top of the pipe, or whenever any sheeting is driven for protection of trench walls in water bearing soil, the Engineer shall determine whether or not this section of the sheeting may be removed. Should he determine that any portion of this sheeting must be left in place, it shall be considered as "Extra Work" and will be compensated for on such a basis.

6. Unstable Foundation. Where materials are encountered in the bottom of the trench which are deemed as unsuitable by the Engineer to afford a sufficiently stable pipe foundation, the materials shall be removed to the depth and limits as ordered by the Engineer. Areas undergraded shall be backfilled with approved granular material or materials meeting the approval of the Engineer.

7. Protection of Property. The Contractor shall satisfactorily shore, support, and protect any and all structures and all pipes, sewers, drains, conduits, and other facilities, and shall be responsible for any damage resulting thereto. The Contractor shall not be entitled to any damages or extra pay on account of any postponement, interference, or delay caused by any such structures and facilities being on the line of work, whether they are shown on the plans or not; specifically, but not limited to damage due to delay in utility relocation.

B. Laying and Jointing:

1. Handling and Protection. All pipe shall be protected during installation against

shock and free fall, and be installed without cracking, chipping, breaking, bending, or damage to coating materials. Damaged pipe materials shall be replaced with new materials except as repair may be permitted by the Engineer.

2. Grade Control. Maximum deviation from plan line or grade of any pipe after installation and backfilling shall not be greater than 0.1 foot. All pipe shall have a continuous slope free from depressions that will not drain. The Contractor shall establish such grade control devices as are necessary to maintain the above tolerances.

3. Laying. The laying of pipe in finished trenches shall be commenced at the lowest point and installed with the bell end forward or upgrade. 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.

4. Bedding. The class of bedding required shall be as indicated on the plans or standard details. Bedding shall be rodded, spaded, and compacted as necessary to provide firm uniform support for the pipe; and not subject it to settlement or displacement.

5. Jointing. Preparatory to making pipe joints, all surfaces of the portions of the pipe to be jointed shall be clean and dry. Lubricants, primers, adhesives, etc. that are used shall be compatible with the jointing material recommended or specified.

   Other than for trimming sewer pipe to be flush with the inside walls of storm sewer structures, no pipes may be trimmed unless ordered by the Engineer.

   Trenches shall be kept water-free and as dry as possible during bedding, laying, and jointing, and for as long a period as required to protect the pipe joints and concrete in structures.

   a. Concrete Pipe:

      i. Plastic joint sealant shall be applied to the tongue or spigot prior to the insertion into the bell or groove. A sufficient amount of sealant shall be used to fill the annular joint space with some squeeze out. Wipe the outside surface of the joint with additional material to assure a complete seal.

      ii. Mortar. When cement mortar is used the joint surface shall be clean and soaked with water immediately before the joint is made. A layer of mortar shall be placed in the lower portion of the bell or groove of the installed pipe and on the upper portion of the tongue or spigot of the pipe section to be installed. The tongue or spigot shall then be inserted into the bell or groove of the installed pipe

until the mortar is squeezed out on both the interior and exterior surfaces. The annular joint space shall be completely filled and the abutting joint sections flush and even, with excess mortar struck off.

iii. Flexible Gaskets. Flat gaskets may be cemented to the pipe tongue or spigot. O-ring gaskets shall be recessed in the groove of the pipe tongue or spigot and confined by the bell or groove after the joint is completed. Roll-on gaskets shall be placed around the tongue or spigot and rolled into position as the joint is assembled. Flat gaskets and O-ring gaskets shall be lubricated as recommended by the manufacturer.

1. Flat gasket: Flat flexible gaskets shall conform to ASTM C 443. If there is no recess provided for the gasket, the surface of the tongue shall be cleaned and rubber adhesive applied. Using quick-drying adhesive, gaskets may be applied ahead of the laying operation or in the plant.

2. O-ring gasket: O-ring or roll-on flexible gaskets shall conform to ASTM C 361, Section 4.10. The entire surface of the bell that comes in contact with the rubber gasket shall be well lubricated with a soap lubricant. The entire gasket shall be greased with soap. Only the soap lubricant supplied by the pipe manufacturer shall be used. Adhesive type cements shall not be used.

b. Corrugated Steel Pipe. Corrugated metal pipe joints shall have a gasket and may be either bell and spigot joints or made with external coupling bands. The bands shall be drawn and secured on the pipe by connecting devices as furnished by the manufacturer. Pipe ends for annular corrugation shall be identical to the rest of the pipe barrel (plain ends), or in the case of helical pipe, the pipe ends at the joint shall be reformed to an annular corrugation and flange (reformed end). Gaskets shall be furnished in accordance with the Plans and Special Provisions. Coupling bands shall be reviewed and approved by the Engineer prior to installation.

c. High Density Polyethylene (HDPE) Pipe. HDPE pipe shall be assembled, installed, and backfilled in accordance with the manufacturer's instructions. Joints shall have a gasket and may be either bell and spigot joints or made with external coupling bands. The fittings and couplings bands shall be fabricated from the same material as the pipe conforming to AASHTO M294. The coupling bands shall cover at least two full corrugations of each section of pipe and shall prevent infiltration of soil into

the pipe. Gaskets shall be furnished in accordance with the Plans and Special Provisions. Coupling bands shall be reviewed and approved by the Engineer prior to installation.

During construction of the project in areas subjected to heavy construction equipment traffic, pipe sizes 12″ - 42″ shall have a minimum cover of 3 feet, and pipe sizes 48″- 120″ shall have a minimum cover of 4 feet.

d. Structure Connections: Pipes connected to structures shall be cut parallel with the inside face of the structure for structures having plane walls and parallel with the spring line of the pipe for structures having curved walls. Projection of the pipe beyond the inside face shall not exceed 1 inch (measured at the springline for structures having curved walls).

C. Trench Backfill. The backfilling of the trench shall follow closely behind the pipe laying operation, but not until inspected by the Engineer. In all cases the pipe shall be backfilled the same day as laying.

1. Compacted backfill shall be required for the full depth of the trench above the embedment where beneath structures, street, road, or highway right-of-way, driveways, walks, parking areas, and at all locations shown on the plans or as directed by the Engineer during the progress of the work.

2. The top portion of the backfill beneath established sodded areas shall be finished with at least 12 inches of topsoil corresponding to, or better than, that underlying adjoining sodded areas. Topsoil shall be approved by the Engineer prior to placement, and unless otherwise directed, shall be material previously excavated and stockpiled for the purpose during excavating and grading operations. Grades on areas to receive topsoil shall be established and maintained as a part of the grading operations. Immediately prior to dumping and spreading topsoil, the surface shall be loosened by discing or scarifying to a depth of two inches (2”) to permit bonding of the topsoil to the underlying surface.

3. At the option of the Contractor, compacted backfill may be job-excavated material or graded gravel, except that all street crossings with pipe diameters less than four feet (4’) shall be backfilled with graded gravel, four feet (4’) back of curb to four feet (4’) back of curb. Job-excavated material may be used for compacted backfill when the job-excavated material is finely divided and free from debris, organic material, cinders, or other corrosive material, and stones larger than three inches (3”) in greatest dimension. Large masses of moist, stiff clay shall not be used. Job-excavated material shall be compacted to 95 percent of maximum density at optimum moisture content as determined by ASTM D698 when the test is appropriate, or to 70 percent relative density as determined by ASTM D2049 when that test is appropriate.

Gravel for compacted backfill shall conform to the following gradation:

| Sieve Size | Percent Passing by Weight |
|---|---|
| 1 inch | 100 |
| 3/4 inch | 85- 100 |
| 3/8 inch | 50- 80 |

| Sieve Size | Percent Passing by Weight |
|---|---|
| No. 4 | 35 - 60 |
| No. 40 | 15-30 |
| No. 200 | 5 - 10 |

The gravel mixture shall contain no clay lumps or organic matter. The fraction passing the No. 4 sieve shall have a liquid limit not greater than 25 and a plasticity index not greater than 5. The backfill shall be compacted by a suitable vibratory roller or platform vibrator to not less than 70 percent relative density as determined by ASTM D2049.

4. The method of compaction and the equipment used shall be appropriate for the material to be compacted and shall not transmit damaging shocks to the pipe. The combination of the thickness of the layer, the method of compaction and the type of compaction equipment used shall be at the discretion of the Contractor subject to obtaining the densities as specified above.

5. Backfill shall not be placed when material contains frost, is frozen, or a blanket of snow prevents proper compaction. Backfill shall not contain waste material, organic material, or debris of any kind.

6. Trench backfill above pipe embedment in locations other than those specified shall be compacted to 90 percent of maximum density at optimum moisture content as determined by ASTM D698, unless otherwise permitted by the City Engineer.

7. Uncompacted earth backfill material to be placed above embedments shall be free of brush, roots more than two inches (2") in diameter, debris, cinders, or other corrosive material, and junk, but may contain rubble and detritus from rock excavation, stones, and boulders in certain portions of the trench depth. Uncompacted backfill material above embedments may be placed by any method acceptable to the Engineer which will not impose excessive concentrated or unbalanced loads, shock, or impact on and which will not result in displacement of installed pipe. Uncompacted backfill shall be placed to the extent necessary to prevent excessive future settlement.

8. Compact masses of stiff clay or other consolidated material more than one (1) cubic foot in volume shall not be permitted to fall more than five feet (5') into the trench unless cushioned by at least two feet (2') of loose backfill above pipe embedment.

9. No uncompacted trench backfill material containing rocks, or rock excavation detritus, shall be placed in the upper 18 inches of the trench except with specific permission of the Engineer, nor shall any stone larger than eight (8) inches in its greatest dimension be placed within three feet (3') of the top of pipe. Large stones may be placed in the remainder of the trench backfill only if well separated and so arranged that no interference with backfill settlement will result.

D. Structural Plate Erection. Structural plate pipe, fabricated from hot-dip galvanized steel plates, shall be assembled by bolting individual plates together to erect the pipes or structures as shown on the plans. Bolts, fittings, and other appurtenances shall be furnished by the plate manufacturer. All materials shall be handled in such a manner that they are not chipped, dented, or bent. If the base metal is exposed in any way it shall be rejected, or repaired to the satisfaction of the Engineer.

4006. DRAINAGE MAINTENANCE. Trenches across roadways, driveways, walks, or other traffic ways adjacent to drainage ditches or water courses shall not be backfilled prior to completion of backfilling the trench on the upstream side of the traffic way, to prevent impounding water after the pipe has been laid. Bridges and other temporary structures required to maintain traffic across such unfilled trenches shall be constructed and maintained by the Contractor. Backfilling shall be done so that water will not accumulate in unfilled or partially-filled trenches. All material deposited in roadway ditches or other water courses crossed by the line of trench shall be removed immediately after backfilling is completed and the original section, grades, and contours of ditches or water courses shall be restored. Surface drainage shall not be obstructed longer than necessary.

4007 DISPOSAL OF EXCESS EXCAVATED MATERIALS. Except as otherwise permitted, all excess excavated materials shall be disposed of away from the site of work.

Broken concrete and other debris resulting from pavement or sidewalk removal, excavated rock in excess of the amount permitted to be and actually installed in trench backfill, junk, and debris encountered in excavation work and other similar waste materials shall be disposed of away from the site of the work.

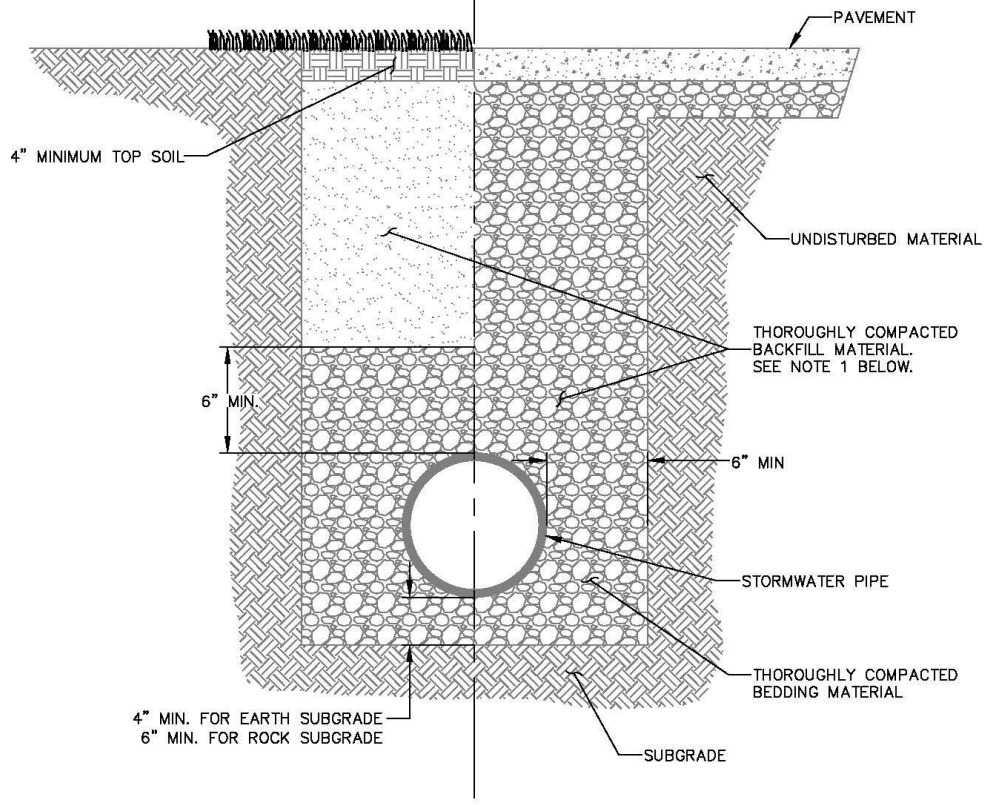
Excess earth from excavations located in unimproved property shall be distributed directly over the pipe trench and within the pipeline right-of-way to a maximum depth of six inches (6") above the original ground surface elevation at and across the trench and sloping uniformly. Drag with blade machine, or other suitable tool to a smooth, uniform surface without obstructing drainage at any point. Wasting of excess excavated material in the above manner will not be permitted where the line of trench crosses or is within a railroad, public road, or highway right-of-way. The disposal of waste and excess excavated materials, including hauling, handling, grading, and surfacing shall be a subsidiary obligation of the contractor and no separate payment will be made

therefore.

4008 SETTLEMENT. The Owner may perform periodic inspections to insure that no settlement has occurred. The Contractor shall be responsible for all settlement of backfill, fills and embankments which may occur within two (2) years of time after final acceptance of the contract under which the work was performed.

The Contractor shall make, or cause to be made, all repairs or replacements made necessary by settlement within thirty (30) days after notice from the Engineer. Should the Contractor fail to make such repairs the Owner may cause repairs to be made and the cost of these repairs shall be the responsibility of the Contractor.

A suitable maintenance bond in an amount approved by the City Engineer shall be furnished to the City of Branson by the Contractor guaranteeing the maintenance of the construction under which the contract was performed. Said bond shall remain in effect for the period mentioned above from the date of completion and acceptance of the work by the City.




NOTES:

1. BACKFILL MATERIAL SHALL BE 3/4" CLEAN ROCK COMPACTED AT 95% DENSITY. SEE SECTION 4005–C OF THE CITY OF BRANSON TECHNICAL SPECIFICATIONS FOR PUBLIC IMPROVEMENTS.

2. 12" MINIMUM COVER FOR PIPES 12"–48" IN DIAMETER. 24" MINIMUM COVER FOR PIPES 54"–60" IN DIAMETER.

3. SUBGRADE SHALL BE MODERATELY FIRM TO HARD IN–SITU SOILS. WHERE UNSUITABLE MATERIAL IS ENCOUNTERED IT SHALL BE REMOVED AND REPLACED WITH CRUSHED AGGREGATE 2 TO 6 INCHES IN SIZE AND COMPACTED TO PROVIDE A STABLE FOUNDATION.

*SEE DETAIL 80–1 FOR STREET PATCH DETAIL

| | | | |
|---|---|---|---|
| Branson MISSOURI ★ Engineering & Public Works | EMBEDMENT AND BACKFILL FOR STORM SEWERS | STANDARD DRAWING 40-1 | |
| | | ADOPTED 2023 | REVISION |

SECTION 4100 STRUCTURES - STORM SEWERS

4101 SCOPE. This section governs the performance of all work necessary for construction of cast-in-place and precast concrete structures for inlets, manholes, junction boxes, box culverts, headwalls, and incidental structures.

4102 MATERIALS.

A. Concrete Mixes. Concrete shall conform to requirements set forth in Section 2000, "Concrete" or meet requirements of MCIB Mix Number A 558-1-2-0.421.

B. For MCIB mixes:

1. Air-entraining admixtures shall provide an air content within the range of 4 1/2 to 7 1/2 percent by volume as measured by the pressure method (ASTM C 231). The air entraining admixtures shall meet the requirements of ASTM C 260.

2. Portland cement: Portland cement shall conform to ASTM C 150 Type I. Where high early strength is desired, Type III can be used.

3. Fine Aggregate: Fine aggregate shall be clean, natural sand meeting the requirements of ASTM C 33. Grading shall be within the limits as set forth by MCIB.

4. Coarse Aggregate: Coarse aggregate shall be limestone meeting the requirements of ASTM C 33. The sum total of all deleterious material shall not exceed the requirements of ASTMC 33.

C. Reinforcing Steel. Reinforcing bars shall conform to ASTM A-615 or AASHTO M 31, Grade 60. Welded steel wire fabric shall conform to ASTM A 1064 or AASHTO M 55.

D. Precast Concrete Structures.

1. Manholes. Precast manholes shall conform to ASTM C-478. Joints between concrete manhole sections shall be made with plastic joint compound or preformed plastic compound as specified in Section 4004. Minimum cross sectional area of preformed compound shall be one inch (1") square or one and a quarter inches (1 ¼") diameter.

2. End Sections for Concrete Pipe. Shall be flared end sections of the pipe manufacturer's standard design, and shall meet all applicable requirements of ASTM C-76 for Class II or higher classes of pipe.

3. Rectangular Structures. Shall conform to the inside dimension indicated on the drawings and be designed for the following loads:

a. HS-20 live load for all structures in/or under pavement, shoulders,

driveways, and other traffic areas.

b. 2,000-lb wheel live load for curb opening inlets and junction boxes in non-traffic areas.

c. 50 pcf, equivalent fluid pressure for soil pressure on vertical walls.

d. 120 pcf for unit weight of soil cover on top slabs.

4. Joints: Joints between concrete structures shall be filled with plastic joint compound or preformed plastic compound as stated herein.

a. Barrel Sections: Minimum cross sectional area of preformed compound between concrete barrel sections shall be 1 inch square or 1.25 inches' diameter. Minimum cross-sectional area of the preformed compound between the concrete adjustment ring and cone barrel section shall be two beads of either 1 inch square or 1.25 inches in diameter.

b. Manhole Adjustment Rings: On manhole grade adjustments smaller than 4 inches, high density polyethylene (HDPE) adjustment rings or Cretex Pro-Rings shall be used or approved equal. On manhole grade adjustments 4 inches and larger, precast reinforced concrete adjustment rings shall be used.

i. Precast Reinforced Concrete, HDPE Adjustment Rings or Cretex Pro-Rings meeting HS-20 loading.

ii. High Density Polyethylene (HDPE) adjustment rings.

The adjustment rings shall be manufactured from polyethylene plastic as identified in ASTM Designation D-1248 (Standard Specification for Polyethylene Plastic Molding and Extrusion Materials).

The plastic rings shall be manufactured utilizing the injection molding process as defined by SPE (Society of Plastic Engineers).

The adjustment rings shall be tested to assure compliance with impact and loading requirements per the ASSHTO Standard Specification for Highway Bridges.

The annular space between the rings and cone basin, the rings, and the rings and cover frame shall be sealed utilizing an approved butyl sealant.

Installation shall be per manufacturer's recommendations only.

iii. Cretex Pro-Ring shall be installed per manufacturers specifications.

c. Manhole Ring and Covers: Minimum cross-sectional area of preformed compound between the concrete adjustment ring and the manhole casting shall be two beads of either 1 inch square or 1.25 inches in diameter.

d. Manhole Chimney Frame Seal: Mastic shall be place between adjustment rings, frame and cone per Section 2500.

E. Cement Mortar. Pre-mix mortar non-shrink or expansive grout in mortar for packing pipe in openings of precast structures, setting castings, and other incidental work shall consist of one part portland cement and two parts sand by volume mixed with sufficient water to form a workable stiff grout.

F. Air Entrainment: All concrete shall be air entrained. Minimum strength requirements shall be as specified in Section 4102.B Concrete Mixes.

G. Manhole Castings.

1. Rings and Covers: Castings shall be gray iron conforming to ASTM A-48, Class 35B. Castings of rings and covers shall be of the shape, dimension, minimum weight and type as indicated on Plans or Standard Drawings and be free from manufacturing defects. All curb inlet castings shall have cam locks or approved equal. If requested by special order, castings shall be cleaned and painted with one coat of tar prior to delivery. Bearing surfaces between all rings and covers for installation in all areas shall be machined to provide even seating. Manhole rings and covers shall be Clay and Bailey No. 2008BV, Deeter No. 1315 or approved equal. Inlet rings and covers shall be Clay and Bailey No. 2020, Deeter No. 2016 or approved equal.

All manhole rings and covers placed in paved areas shall be rated for H20 traffic. Cam lock covers or similar shall not be placed in roadway pavement unless shown on the Plans or directed by the Engineer. All covers shall have provisions for opening, such as concealed pick holes.

2. Steps: All steps shall be steel core, plastic coated steps. Steel core plastic coated steps shall meet the following minimum requirements.

a. The plastic coating shall be a copolymer polypropylene meeting ASTM D 4101.

b. The steel core shall be a minimum of ½ inch diameter and grade 60.

c. The requirements of ASTM C 478 shall be met except minimum pull-out strength shall be 1,000 pounds.

H. Metal End Sections. Metal end sections shall be fabricated from galvanized base metal as specified in Section 4000, and shall be flared end sections of the metal pipe manufacturer's standard design. End sections shall be furnished with a metal toe plate. Bituminous coating is not required.

I. Toe Walls. Flared end sections for concrete and metal pipe shall be set on a concrete toe

wall centered on the end of the section or formed with the flared end section. Concrete toe walls shall be eight inches (8") thick by 24 inches deep by the width of the end section.

4103 CONSTRUCTION DETAILS.

A. Concrete Structures. Concrete construction shall conform to the requirements set forth in Section 2000, "Concrete" and also the current ACI 301 Specifications for Structural Concrete.

1. Precast Structures. The Contractor may, at his option, construct precast concrete inlets, junction boxes, and box culverts, in lieu of the cast-in-place structures indicated on the drawings; except that all concrete base slabs for pre-cast inlets, manholes, and junction boxes may be cast-in-place. Solid concrete brick or block shall be used to block inlets and similar structures to grade during placement of base slab concrete.

Precast concrete box culvert sections shall be installed on a four inch (4") leveling course of untreated compacted aggregate conforming to the following:

| U.S. Standard Square Mesh Sieve | Percent Passing Square Mesh Sieve |
|---|---|
| 1 1/4" | 100 |
| 1" | 72-100 |
| 3/4" | 60-90 |
| 3/8" | 43-74 |
| No. 4 | 28-60 |
| No. 10 | 16-40 |
| No. 40 | 3-22 |
| No. 200 | 0-15 |

In addition to the above limits, the difference between the "Percent Passing Square Mesh Sieve" of successive sieve sizes shall not exceed 25. That fraction of the material passing the No. 40 Sieve shall have a plasticity index not to exceed 8 when tested in accordance with ASTM D-423, and D-424.

Leveling courses shall extend one foot past the line of the box section, and be finished to a true plane surface to provide uniform bearing for the precast section.

Any adjustments required for precast structures to meet field conditions shall be at the cost of the Contractor.

2. Finishing. Exposed edges of all slabs, walls, and other concrete structures shall be beveled 3/4" or edged with a 1-1/4" radial tool.

3. Exposed Slabs. Finish for exposed slabs shall be wood float texture in accordance with MCIB Specification Section 24. Exposed edges shall be beveled or edged with a radial tool.

4. Form Removal. Forms shall remain in place until the concrete has attained sufficient strength to support loads imposed by backfilling, construction, and traffic, but not less than:

   a. Walls. Forms shall remain in place for a minimum of three (3) days or until the concrete reaches a minimum strength of 2000 p.s.i.

   b. Slabs. Form shall remain in place for a minimum of seven (7) days or until the concrete reaches a minimum strength of 3000 p.s.i.

B. Brick and Masonry Structures.

1. Wet brick units thoroughly before laying. Each brick shall be laid with push joints in a full bed of mortar. The mortar shall fully cover the bottom and ends of the brick and surplus mortar on the inside face shall be removed and mortar joints on the inside face shall be well filled with a suitable pointing iron before initial set and be left with a smooth hard finish.

2. Lay brick in a stretcher course with every sixth course a header.

3. Plaster outside surfaces of brick structures with 1/2-inch-thick mortar troweled to a smooth hard finish. Cure with liquid membrane curing compound.

4. Protect new masonry work from loss of moisture while curing and protect from frost damage during freezing weather.

C. Invert Channels. Form concrete invert channels in manholes, inlets, and junction boxes to make changes in direction of flow with smooth curves of as large a radius as permitted by the inside dimension of the structure. Grade changes and transitions shall be smooth and uniform and all parts of the invert channel and adjacent floor shall slope to drain. Channel bottom shall be finished smooth without roughness or irregularity. Invert channels for precast concrete structures may be cast integrally with the structure base slabs at the Contractor's option.

D. Excavation and Backfill. All excavation and backfill shall be in conformance with Section 1100 entitled "Grading" and as specified herein.

1. Excavation. Excavation for structures shall be carried a sufficient distance, but not less than 18 inches outside the limits of the structure to permit efficient erection and removal of forms and laying of masonry units, and shall be sloped, stepped, or braced as required for stability. When unsuitable soils are encountered at the bearing elevation of the structure, they shall be removed and replaced with either fill concrete or compacted granular material at the Contractor's option. Over excavation shall be corrected in like manner. The Contractor shall maintain the excavation free of standing water until backfilling is complete.

2. Backfilling. Backfilling shall conform to the requirements of Section 4005(C) and as follows:

   a. No backfill shall be placed over or around any structure until the concrete or mortar therein has attained a minimum strength of 2000 p.s.i. and can sufficiently support the loads imposed by the backfill without damage.

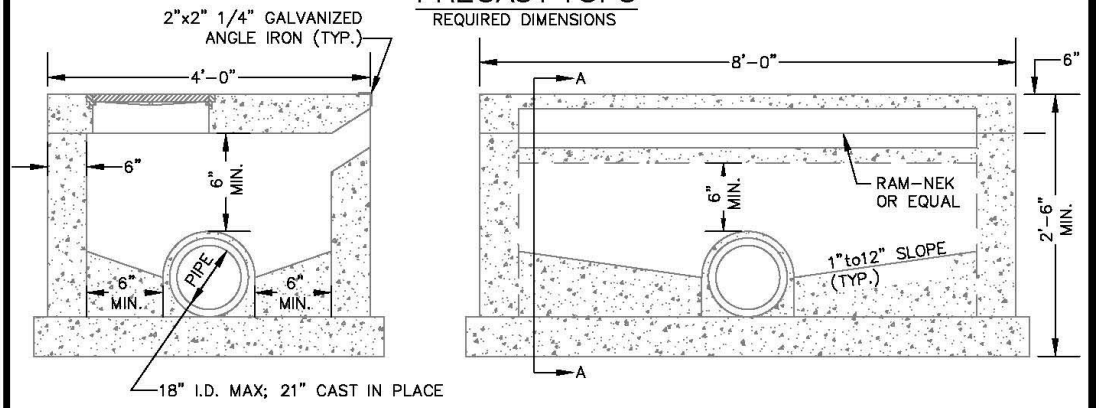
   b. The Contractor shall use utmost care to avoid any wedging action between the side of the excavation and the structure that would cause any movement of the structure. Any damage caused by premature backfill or by the use of equipment on or near a structure will be the responsibility of the Contractor.

   c. Backfill shall be placed and compacted on all sides of the structure simultaneously, and operations shall be so conducted that the backfill is always at approximately the same elevation on all sides of the structure.

   d. No excavated rock larger than four inches (4”) maximum dimension shall be placed within one foot (1’) of the exterior surface of any structure

## PRECAST TOPS

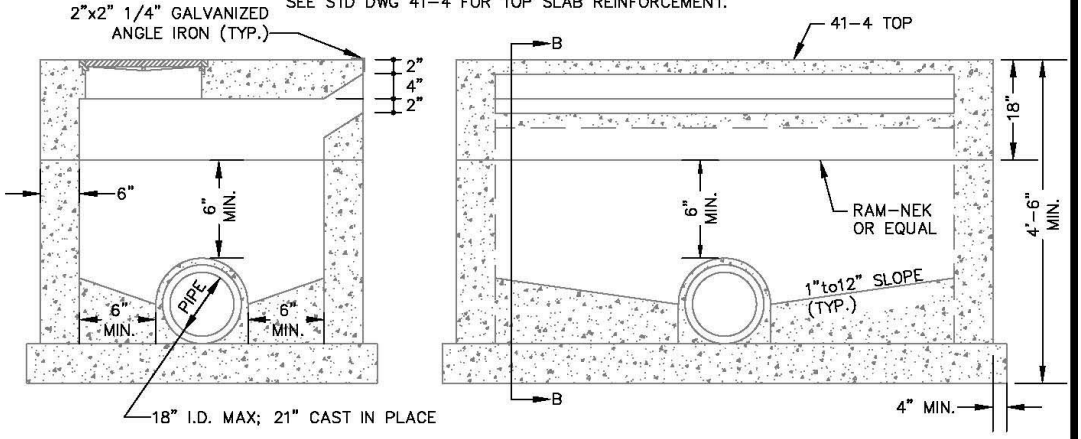
REQUIRED DIMENSIONS




SECTION A–A

## FOR 6" PRECAST TOP

NOTE: #4Ø AT 10" O.C. (ALL WALLS, VERT. & HORZ.)
SEE STD DWG 41–4 FOR TOP SLAB REINFORCEMENT.

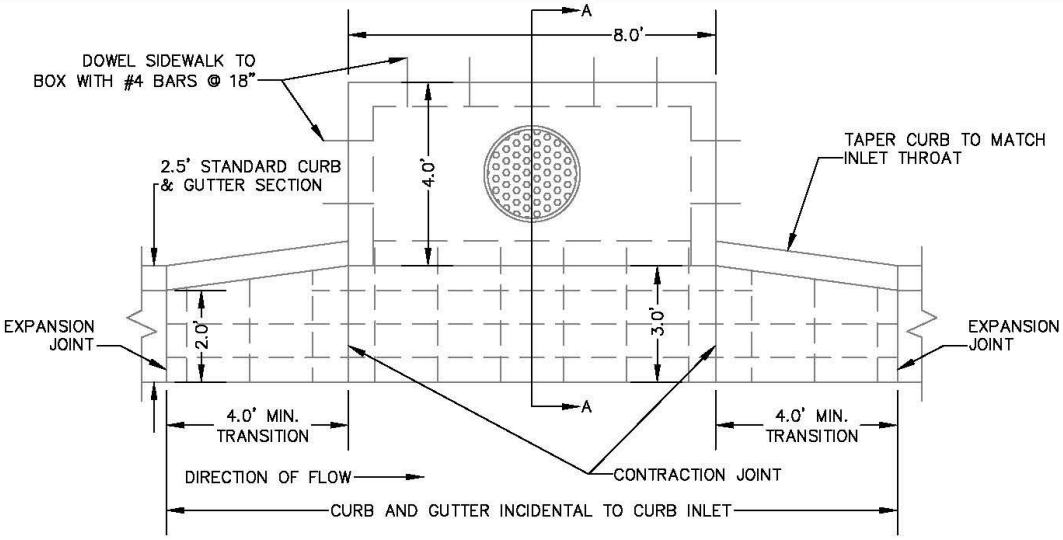


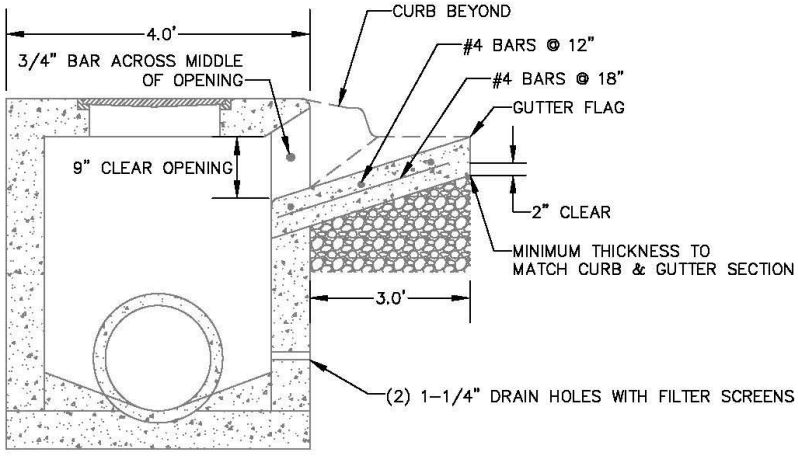

SECTION B–B

## FOR STD DWG 41-4 TOP (18" PRECAST TOP)

NOTES:
1. BOTTOM TO BE POURED IN PLACE
2. PIPE TO BE ON GRADE BEFORE BOTTOM IS CONSTRUCTED.
3. FOR 6" TOP, USE 4 – #4Ø DOWELS: ONE IN EACH CORNER WITH RAM–NEK OR EQUAL.
4. RAM–NEK ALL JOINTS (OR EQUAL).
5. 6" INVERT REQUIRED TO PREVENT SEDIMENTATION.
6. THERE MUST BE A 6" MIN. CONCRETE SEGMENT ABOVE PRECAST OPENING.
7. IF CLEARANCE CAN'T BE PROVIDED FROM TOP AND SIDES OF PIPE, A MODIFIED INLET MUST BE USED.

| | | |
|---|---|---|
| Branson MISSOURI Engineering & Public Works | NON-RECESSED STANDARD CURB INLET DETAIL | STANDARD DRAWING 41-1 |
| | | ADOPTED 2023 / REVISION |



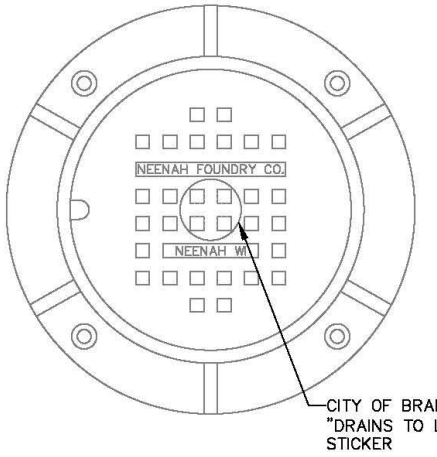



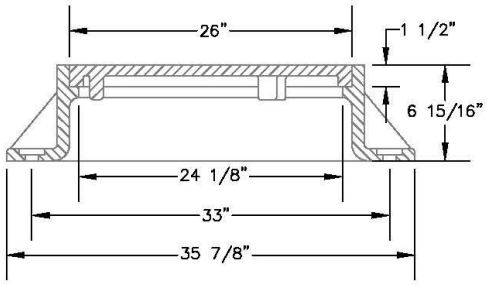

SECTION A-A

NOTES:
1. #4 BARS @ 10" O.C. (ALL WALLS, VERT. & HORIZ.)
2. IF CLEARANCE CAN'T BE PROVIDED FROM TOP AND SIDES OF PIPE, A MODIFIED INLET MUST BE USED.
3. 6", 12" OR 18" PRECAST LIDS MAY BE USED.
4. IF INLET IS NOT RECESSED, THROAT OPENING IS 7 INCHES.
5. CURB AND GUTTER CONSTRUCTED IN FRONT OF INLET AND ON EACH SIDE OF INLET AS SHOWN ABOVE SHALL BE CONSIDERED INCIDENTAL TO THE COST OF THE CURB INLET.

| | | |
|---|---|---|
| Branson MISSOURI Engineering & Public Works | STANDARD CURB INLET DETAIL | STANDARD DRAWING 41-2 |
| | | ADOPTED 2023 / REVISION |

## RING & COVER DETAILS



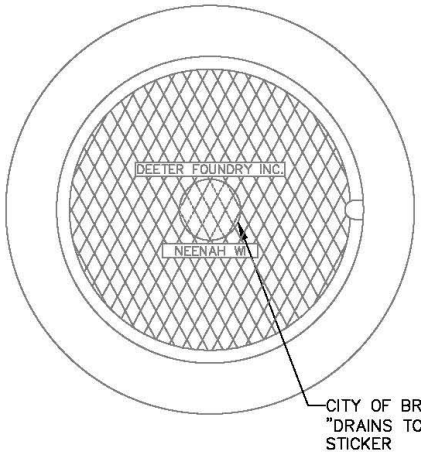



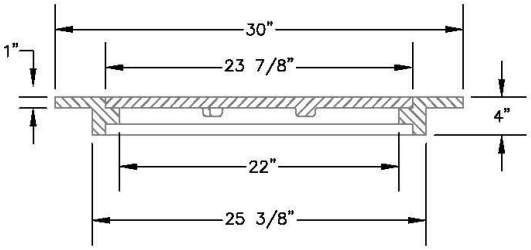

NOTE:
1. FURNISHED WITH MACHINED HORIZONTAL BEARING SURFACES.

## TYPE "A" RING & COVER

NEENAH #R-1642 RING & COVER, EAST JORDAN IRON WORKS #2420Z RING W/ 2408A COVER, STD DWG 41-3 INSTALLED FLANGE DOWN OR EQUAL

## RING & COVER DETAILS




NOTE:
1. FURNISHED WITH MACHINED HORIZONTAL BEARING SURFACES.
2. RING IS REVERSIBLE AND CAN BE INSTALLED WITH FLANGE UP OR DOWN.

## TYPE "C" RING & COVER

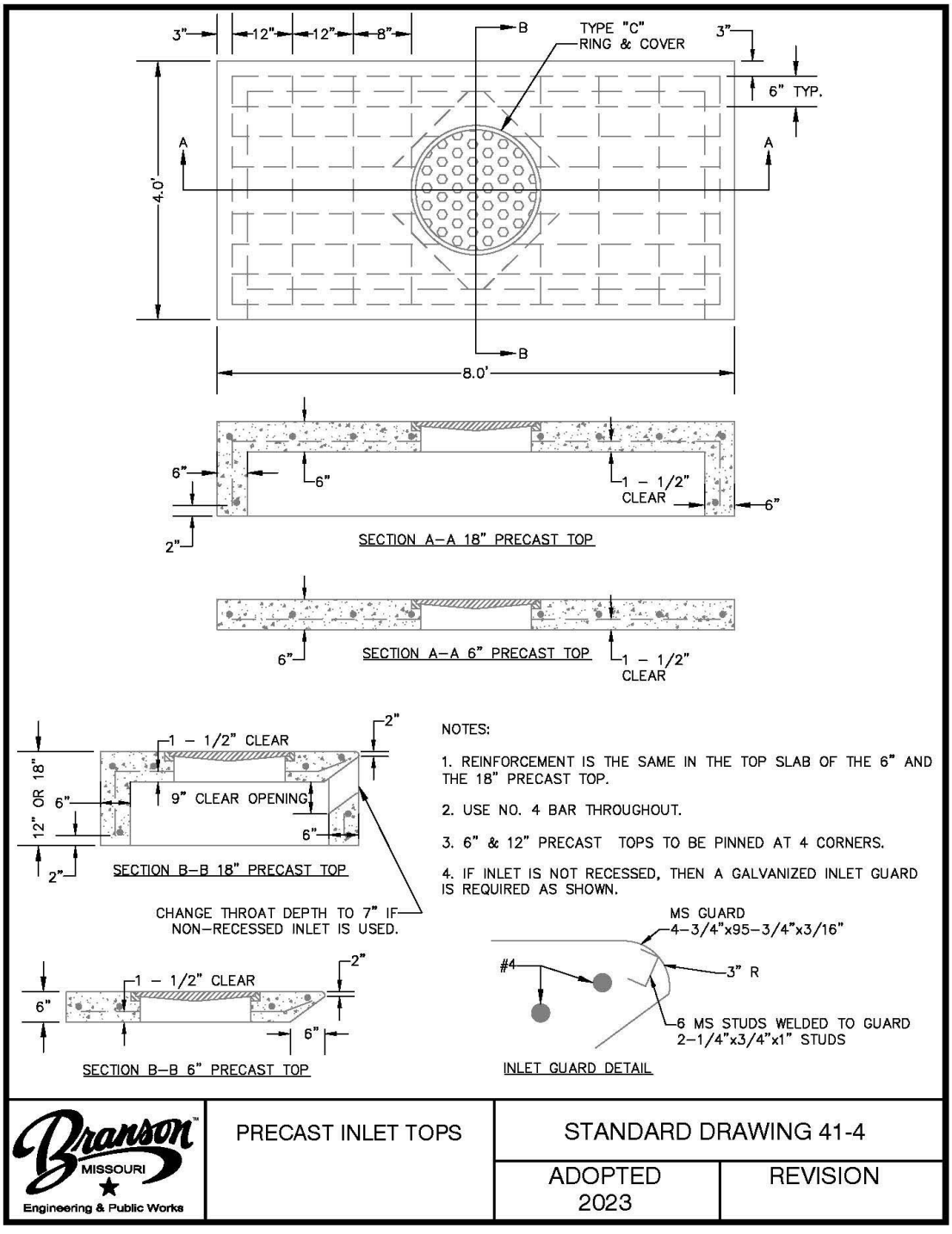
DEETER #1157 RING W/ 2018A COVER, EAST JORDAN IRON WORKS #2425Z RING OR EQUAL

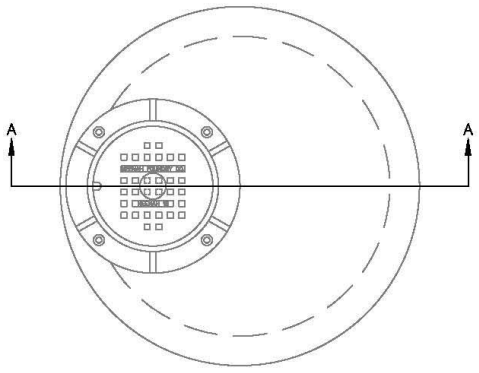
Branson MISSOURI
Engineering & Public Works

TYPES "A" & "C"
RING & COVER FOR
STORM SEWER INLET

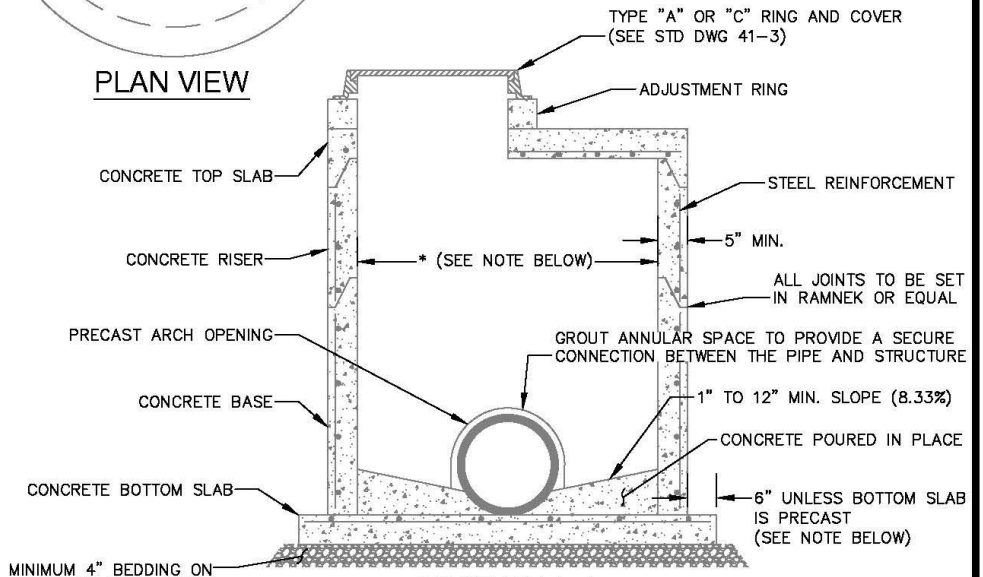
STANDARD DRAWING 41-3

| ADOPTED | REVISION |
|---|---|
| 2023 | |


3"
12"
12"
8"
B
TYPE "C"
RING & COVER
3"
6" TYP.
A
A
4.0'
B
8.0'
6"
6"
1 – 1/2"
CLEAR
6"
2"
SECTION A–A 18" PRECAST TOP
6"
SECTION A–A 6" PRECAST TOP
1 – 1/2"
CLEAR
2"
1 – 1/2" CLEAR
12" OR 18"
6"
9" CLEAR OPENING
6"
2"
SECTION B–B 18" PRECAST TOP
CHANGE THROAT DEPTH TO 7" IF
NON–RECESSED INLET IS USED.
NOTES:
1. REINFORCEMENT IS THE SAME IN THE TOP SLAB OF THE 6" AND THE 18" PRECAST TOP.
2. USE NO. 4 BAR THROUGHOUT.
3. 6" & 12" PRECAST TOPS TO BE PINNED AT 4 CORNERS.
4. IF INLET IS NOT RECESSED, THEN A GALVANIZED INLET GUARD IS REQUIRED AS SHOWN.
MS GUARD
4–3/4"x95–3/4"x3/16"
#4
3" R
6 MS STUDS WELDED TO GUARD
2–1/4"x3/4"x1" STUDS
INLET GUARD DETAIL
2"
1 – 1/2" CLEAR
6"
6"
SECTION B–B 6" PRECAST TOP
Branson
MISSOURI
Engineering & Public Works
PRECAST INLET TOPS
STANDARD DRAWING 41-4
ADOPTED
2023
REVISION




PLAN VIEW




SECTION A-A

NOTES:
1. MANHOLE SHALL BE DESIGNED AND MANUFACTURED IN ACCORDANCE WITH ASTM C 478.
2. BOTTOM SLAB SHALL BE POURED IN PLACE. IF MANUFACTURER IS CONCERNED ABOUT STRUCTURAL INTEGRITY OF CONCRETE BASE DURING TRANSPORTATION, THE BOTTOM SLAB MAY BE PRECAST WITH CONCRETE BASE.
3. PIPE TO BE ON GRADE BEFORE BOTTOM SLAB IS CONSTRUCTED.
4. ALL PIPES SHALL FIT FLUSH AT SPRINGLINE WITH INSIDE FACE OF MANHOLE.
5. BOTTOM OF MANHOLE TO BE FILLED WITH CONCRETE FORMING CHANNELS TOWARD OUTLET PIPE FROM ALL INLET PIPES. CONCRETE SHALL BE FLUSH WITH INVERT OF OUTLET PIPE.
6. NO MORE THAN 2 ADJUSTMENT RINGS MAY BE USED AND SHALL NOT EXCEED 18 INCHES.
7. A MINIMUM CLEARANCE OF TWO FEET, MEASURED AT THE INSIDE FACE OF THE MANHOLE, SHALL BE MAINTAINED BETWEEN THE OUTSIDE EDGE OF STORM SEWER PIPES.

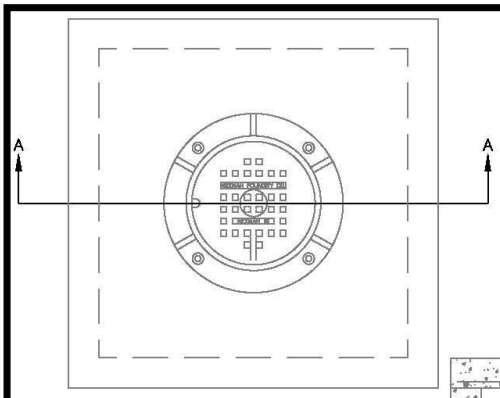
| PIPE DIAMETER | * MINIMUM DIAMETER OF MANHOLE (SEE NOTE 7) |
|---|---|
| 15" – 24" | FOUR FEET (4') |
| 27" – 42" | FIVE FEET (5') |
| 48" | SIX FEET (6') |
| 54" – 66" | EIGHT FEET (8') |

Branson MISSOURI
Engineering & Public Works

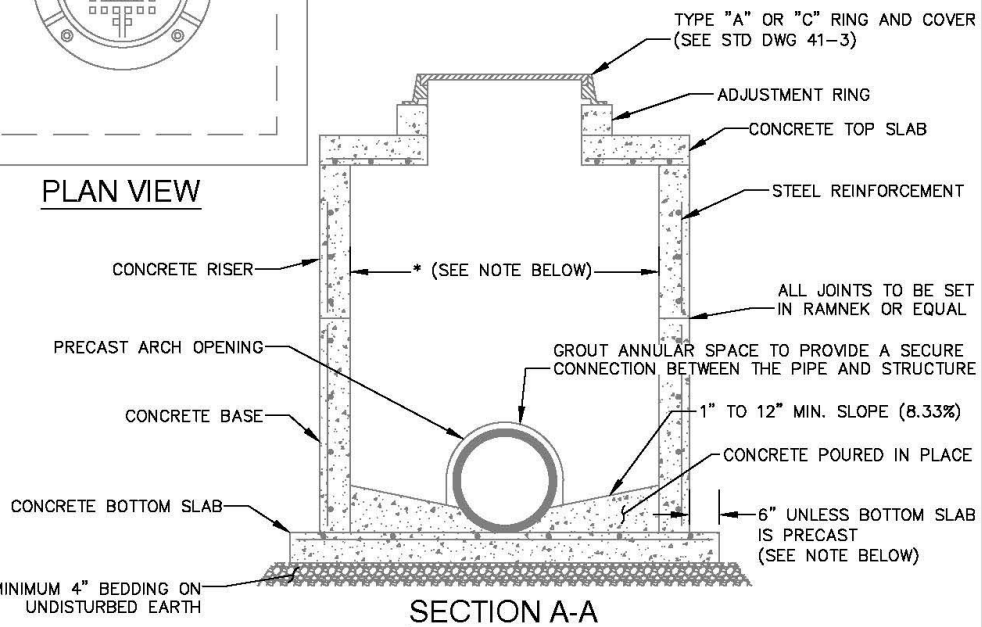
STANDARD STORM SEWER MANHOLE

STANDARD DRAWING 41-5

| ADOPTED | REVISION |
|---|---|
| 2023 | |




PLAN VIEW




SECTION A-A

NOTES:
1. JUNCTION BOX SHALL BE DESIGNED AND MANUFACTURED IN ACCORDANCE WITH ASTM C 913 FOR A COMBINATION OF DEAD LOADS AND A-16 (HS20-44) TRAFFIC LOADS IN ACCORDANCE WITH ASTM C890.
2. FOR CAST-IN-PLACE STRUCTURES, THE ENGINEER SHALL SUBMIT A DRAWING FOR THE DESIGN OF THE STRUCTURE, INCLUDING SIZE AND SPACING OF REINFORCEMENT AND THICKNESS OF CONCRETE IN WALLS, TOP SLAB AND BOTTOM SLAB FOR SAME LOADING AS SPECIFIED IN NOTE 1.
3. JUNCTION BOX SHALL BE CONSTRUCTED WITH AS FEW JOINTS AS REASONABLY PRACTICAL. WHEN JOINTS ARE NECESSARY, JOINTS SHALL BE WATERTIGHT, DETAILED ON SHOP DRAWINGS AND DESIGNED TO PREVENT LATERAL MOVEMENT DURING AND AFTER CONSTRUCTION.
4. BOTTOM SLAB SHALL BE POURED IN PLACE. IF MANUFACTURER IS CONCERNED ABOUT STRUCTURAL INTEGRITY OF BASE DURING TRANSPORTATION, THE BOTTOM SLAB MAY BE PRECAST WITH RISER.
5. PIPE TO BE ON GRADE BEFORE BOTTOM SLAB IS CONSTRUCTED UNLESS BOTTOM IS PRECAST WITH BASE.
6. ALL PIPES SHALL FIT FLUSH WITH INSIDE FACE OF JUNCTION BOX.
7. BOTTOM OF JUNCTION BOX TO BE FILLED WITH CONCRETE FORMING CHANNELS TOWARD OUTLET PIPE FROM ALL INLET PIPES.
8. NO MORE THAN 2 ADJUSTMENT RINGS MAY BE USED AND SHALL NOT EXCEED 18 INCHES.
9. CONCRETE TOP SLAB SHALL BE PINNED TO STRUCTURE AT THE CORNERS USING ONE #4 DEFORMED BAR IN EACH CORNER. BAR SHALL EXTEND A MINIMUM OF 6 INCHES INTO RISER BELOW.

| PIPE DIAMETER | * MINIMUM DIAMETER OF STRUCTURE |
|---|---|
| 15" – 24" | THREE FEET (3') |
| 27" – 30" | FOUR FEET (4') |
| 36 – 42" | FIVE FEET (5') |
| 48" – 54" | SIX FEET (6') |

Branson MISSOURI
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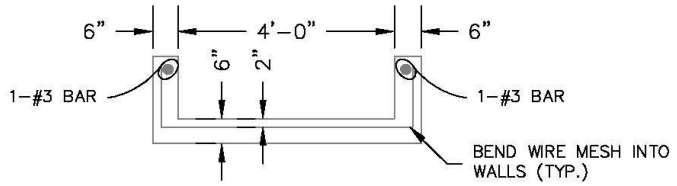
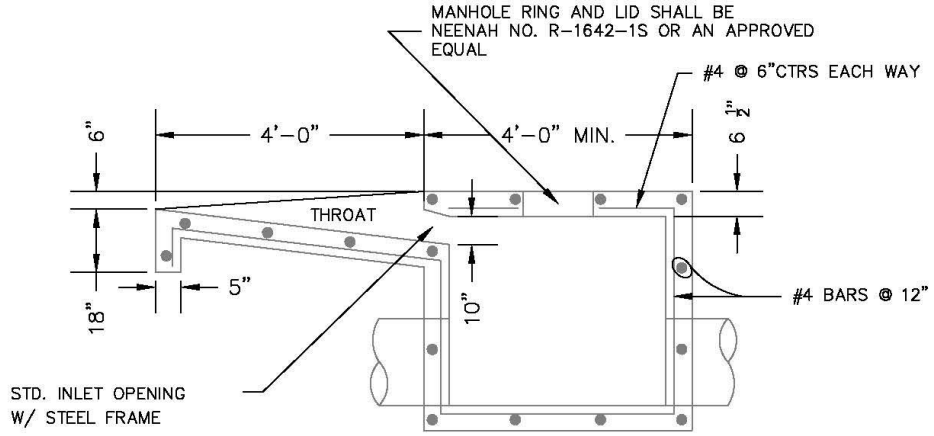
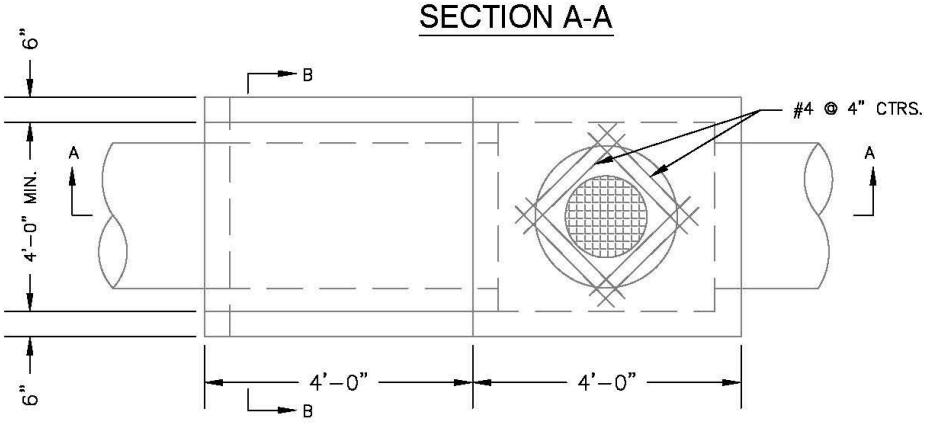
| JUNCTION BOX DETAIL | STANDARD DRAWING 41-6 | |
|---|---|---|
| | ADOPTED 2023 | REVISION |




SECTION B-B

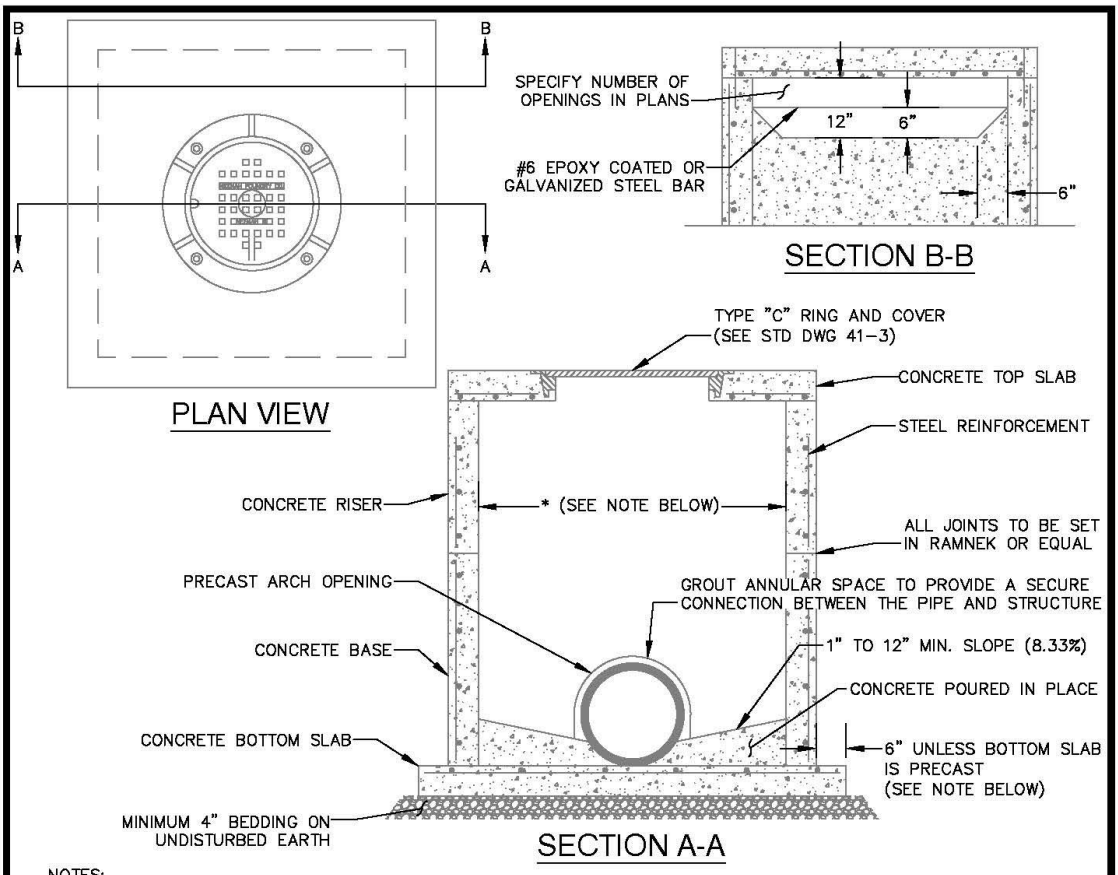



SECTION A-A




PLAN

| | | | |
|---|---|---|---|
| Branson MISSOURI Engineering & Public Works | YARD INLET DETAIL | STANDARD DRAWING 41-7 | |
| | | ADOPTED 2023 | REVISION |

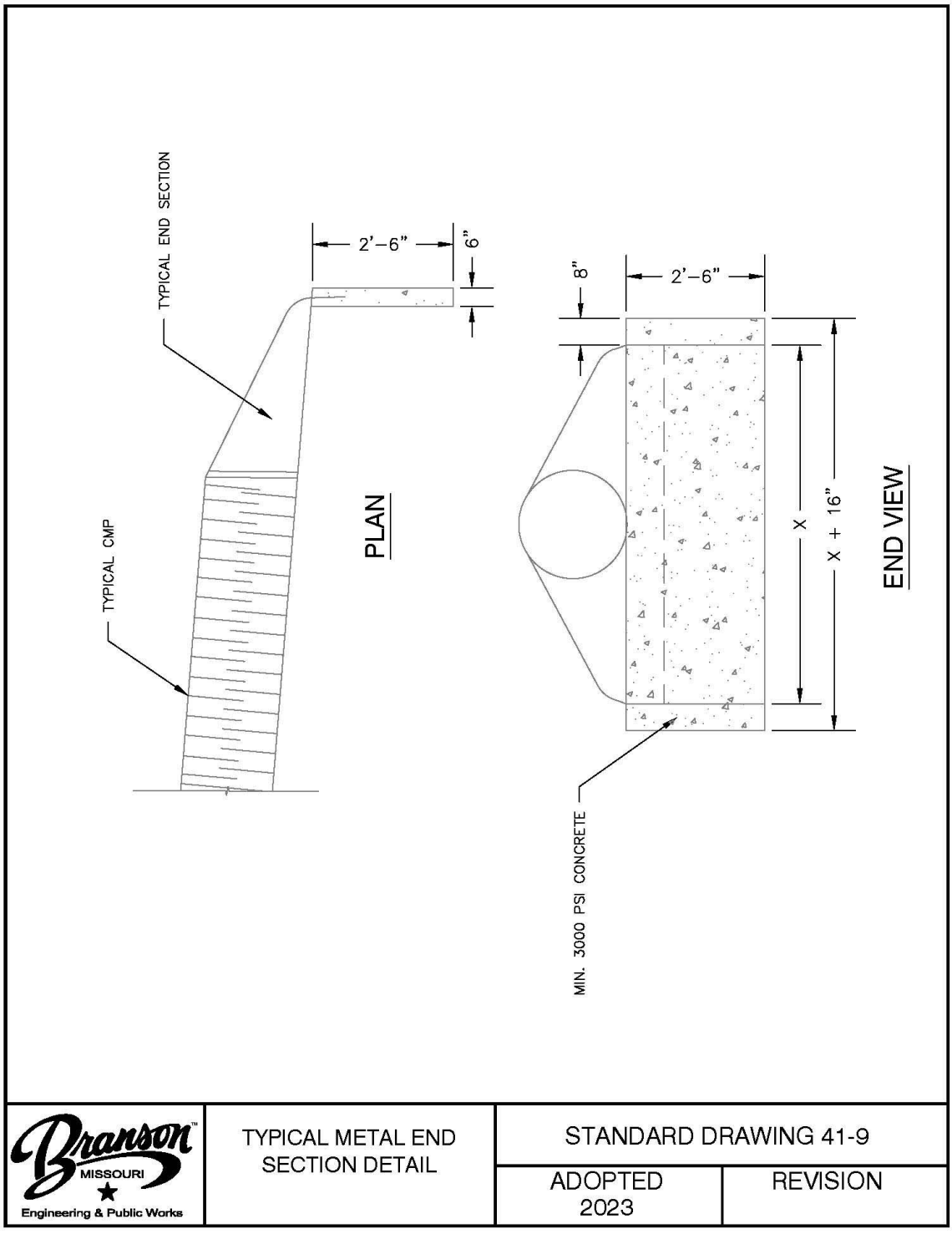



NOTES:
1. AREA INLET SHALL BE DESIGNED AND MANUFACTURED IN ACCORDANCE WITH ASTM C 913 FOR A COMBINATION OF DEAD LOADS AND A-16 (HS20-44) TRAFFIC LOADS IN ACCORDANCE WITH ASTM C890.
2. FOR CAST-IN-PLACE STRUCTURES, THE ENGINEER SHALL SUBMIT A DRAWING FOR THE DESIGN OF THE STRUCTURE, INCLUDING SIZE AND SPACING OF REINFORCEMENT AND THICKNESS OF CONCRETE IN WALLS, TOP SLAB, AND BOTTOM SLAB FOR SAME LOADING AS SPECIFIED IN NOTE 1.
3. AREA INLET SHALL BE CONSTRUCTED WITH AS FEW JOINTS AS REASONABLY PRACTICAL. WHEN JOINTS ARE NECESSARY, JOINTS SHALL BE WATERTIGHT, DETAILED ON SHOP DRAWINGS AND DESIGNED TO PREVENT LATERAL MOVEMENT DURING AND AFTER CONSTRUCTION.
4. BOTTOM SLAB SHALL BE POURED IN PLACE. IF MANUFACTURER IS CONCERNED ABOUT STRUCTURAL INTEGRITY OF CONCRETE BASE DURING TRANSPORTATION, THE BOTTOM SLAB MAY BE PRECAST WITH CONCRETE BASE.
5. PIPE TO BE ON GRADE BEFORE BOTTOM SLAB IS CONSTRUCTED UNLESS BOTTOM IS PRECAST WITH BASE.
6. ALL PIPES SHALL FIT FLUSH WITH INSIDE FACE OF INLET.
7. BOTTOM OF INLET TO BE FILLED WITH CONCRETE FORMING CHANNELS TOWARD OUTLET PIPE FROM ALL INLET PIPES. CONCRETE SHALL BE FLUSH WITH INVERT OF OUTLET PIPE.
8. CONCRETE TOP SLAB SHALL BE PINNED TO STRUCTURE AT THE CORNERS USING ONE #4 DEFORMED BAR IN EACH CORNER. BAR SHALL EXTEND A MINIMUM OF 6 INCHES INTO RISER BELOW.

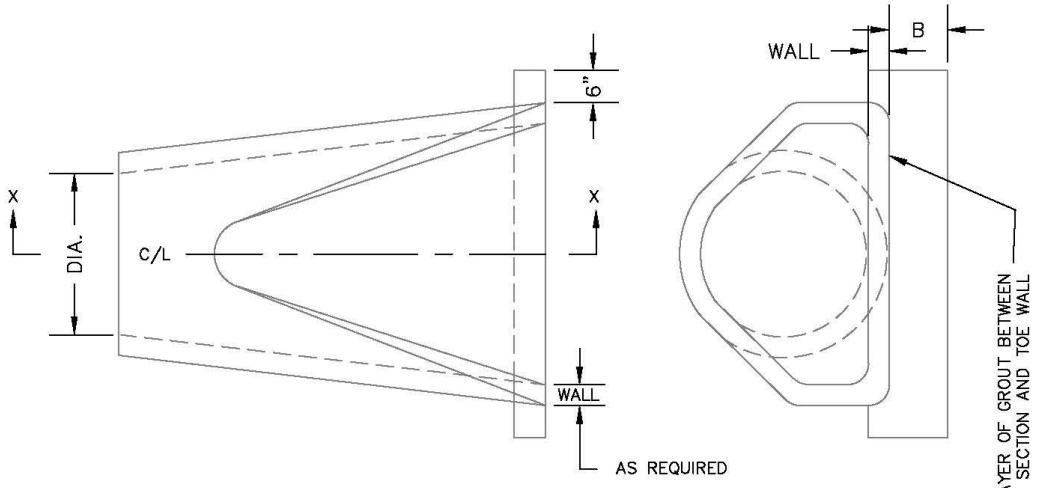
| PIPE DIAMETER | * MINIMUM DIAMETER OF STRUCTURE |
|---|---|
| 15" – 24" | THREE FEET (3') |
| 27" – 30" | FOUR FEET (4') |
| 36 – 42" | FIVE FEET (5') |
| 48" – 54" | SIX FEET (6') |

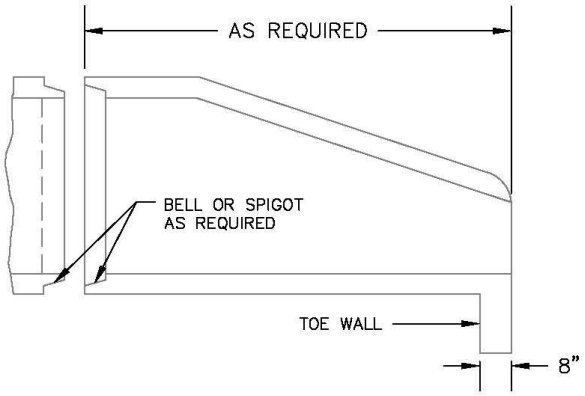
Branson MISSOURI
Engineering & Public Works

| AREA INLET DETAIL | STANDARD DRAWING 41-8 | |
|---|---|---|
| | ADOPTED 2023 | REVISION |




| | | | |
|---|---|---|---|
| Branson MISSOURI ★ Engineering & Public Works | TYPICAL METAL END SECTION DETAIL | STANDARD DRAWING 41-9 | |
| | | ADOPTED 2023 | REVISION |




SECTION X-X

| DIMENSIONS | |
|---|---|
| DIA. | B |
| 12"–21" | 18" |
| 24"–48" | 24" |
| 54"–66" | 36" |

| | | | |
|---|---|---|---|
| Branson MISSOURI ★ Engineering & Public Works | TYPICAL PRECAST END SECTION DETAIL | STANDARD DRAWING 41-10 | |
| | | ADOPTED 2023 | REVISION |

GENERAL NOTES:
1. RCB'S SHALL BE DESIGNED TO CARRY AASHTO H52044 LOADING AS OUTLINED IN THE STANDARD SPECIFICATIONS FOR HIGHWAY BRIDGES. ADOPTED BY THE AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS 1977 EDITION.
2. ALL CONCRETE SHALL DEVELOP A MINIMUM 28 DAY COMPRESSIVE STRENGTH OF 4000 PSI.
3. REINFORCING STEEL SHALL BE ASTM A-615 GRADE 60, EXCEPT TIES AND STIRRUPS WHICH SHALL BE GRADE 40.
4. AT ALL HOLES IN CONCRETE WALLS, ADD 4 #5 BARS (OPENING DIMENSION PLUS 60 BAR DIAMETERS LONG) DIAGONALLY TO THE MAIN WALL REINFORCEMENT. SPREAD MAIN REINFORCEMENT AT ALL PENETRATIONS. DO NOT CUT OR ELIMINATE.
5. A CONCRETE SEAL COURSE SHALL BE CONSTRUCTED WHERE SPECIFIED ON THE PLANS OR BY THE CITY ENGINEER. ALL RCB BASE SLAB SHALL BE CONSTRUCTED OF STABLE SUBGRADE.
6. KEYED JOINTS SHALL BE PROVIDED AS SHOWN IN ALL CULVERTS WHERE THE LENGTH IS 40' OR MORE. THESE JOINTS SHALL BE SPACED SO AS THE DIVIDE THE BOX INTO SECTIONS OF EQUAL LENGTH. THE REINFORCING STEEL SHALL BE CARRIED THROUGH EACH KEYED JOINT AND STEEL LAPS SHALL BE 24 TIMES THE BAR DIAMETER OR A MINIMUM OF 12".
7. STANDARD CONCRETE COVER OF BARS UNLESS OTHERWISE NOTED SHALL BE
WHERE DIRT FORMED..... 3"
CONCRETE EXPOSED TO EARTH OR WEATHER
#5 BARS OR SMALLER..... 1 1/2"
#6 THROUGH #18 BARS..... 2"
8. BACKFILLING MAY NOT BEGIN UNTIL THE CONCRETE REACHES A STRENGTH EQUAL TO 75% OF THE DESIGN STRENGTH OF THE CONCRETE (4000 PSI) IS ATTAINED PRIOR TO THE 14 DAY PERIOD.
9. A STANDARD 42" HIGH CHAIN LINK FENCE SHALL BE REQUIRED AT EACH END OF ALL RCB'S UNLESS APPROVED OTHERWISE BY THE CITY ENGINEER. FENCING SHALL EXTEND CONTINUOUSLY ALONG THE GUARD AND DOWN EACH WING WALL.
10. HUB GUARDS SHALL BE DESIGNED TO ACCOMMODATE GRADING WITH A 6:1 MAXIMUM SLOPE BETWEEN BACK OF CURB AND THE HUB GUARD (OR EDGE OF SIDEWALK AND THE HUB GUARD IF APPLICABLE).
11. CONTRACTOR TO SUPPLY AN EXTRA AMOUNT OF REINFORCEMENT, 1% OF LENGTHS AND SIZE, TO BE USED AT THE DISCRETION OF THE CITY ENGINEER.
12. FLOATING APRON SHALL BE REQUIRED AT DOWNSTREAM END OF RCB UNLESS BOTTOM OF CHANNEL REST ON SOUND BEDROCK.
13. TOE WALL TO BE CONSTRUCTED AT EACH END OF THE RCB. TOE WALL TO 3'-2" MINIMUM BELOW FLOW LINE OF RCB OR 6" INTO BEDROCK IF APPLICABLE.
4" TILE DRAIN AT 20'-0" (TYP.) W/ GALV. SCREEN
MESH REINFORCING IN APRON. 2:1/100 SQ. FT.
A
B
D/2
D
PLAN
1'-0" MIN.
1 1/2" CLR
20'-0"
1'-0"
3'-2" MIN.
SECTION A-A
SECTION B-B
NOTE: IF TOP WALLS ARE MONOLITHICALLY POURED THEN UPPER KEYWAY CAN BE DELETED. REBAR MUST BE CONTINUE THROUGH KEYWAY AS SHOWN.
9"
2'-6"
BOTTOM SLAB THICKNESS (VARIES)
GRAVEL BACKFILL FULL LENGTH OF RCB
4" DRAIN
BOTTOM OF BOTTOM SLAB
DETAIL OF COURSE AGG. AROUND TILE DRAINS
Branson MISSOURI
Engineering & Public Works
REINFORCED CONCRETE BOX DETAIL
STANDARD DRAWING 41-11
ADOPTED 2023
REVISION

SECTION 4200 OPEN CHANNELS

4201 SCOPE. This section includes all work for construction of open channel lining at the location, and to the lines, grades and dimension indicated on the drawings. Grading shall have been previously completed in accordance with Sections 1000 and 1100 "Site Preparation" and "Grading".

4202 MATERIALS.

A. Concrete. Concrete and materials shall conform to the requirements set forth in Section 2000, "Concrete".

B. Stone. Stone for riprap, grouted riprap, and gabion linings shall consist of quarried rock and be sound, durable, and angular in shape. No more than 10 percent shall have an elongation greater than 3:1, and no stone shall have an elongation greater than 4:1. Material shall be free from cracks, seams, or other defects. Shale and stone with shale seams are not acceptable.

1. The minimum weight of the stone shall be 155 pounds per cubic foot as computed by multiplying the specific gravity times 62.4 pounds per cubic foot.

2. Not more than 10 percent of the stone shall exhibit splitting, crumbling, or spalling when subject to 5 cycles of the sodium sulfate soundness test in accordance with ASTM C 88.

3. SRiprap: Riprap shall have a minimum thickness of 15 inches, or 1.5 times as thick as the larger stones, whichever is greater.

The gradation for Riprap (light stone) shall be as follows:

| Weight of Stone in Lbs. | Percent Passing by Weight |
|---|---|
| 250 | 100 (minimum) |
| 100 | 50 (maximum) |
| 75 | 70 (maximum) |
| 5 | 10 (maximum) |

The gradation for Riprap (heavy stone) shall be as follows:

| Weight of Stone in Lbs. | Percent Passing by Weight |
|---|---|
| 1000 | 100 (minimum) |
| 500 | 50 (maximum) |
| 75 | 10 (maximum) |

The Contractor shall provide certification that the material meets the specified gradations.

Gabion Fill Stone: Stone shall be of the following gradations:

| U.S. Standard Square Mesh Sieve | Percent Passing by Weight |
|---|---|
| 10” | 100 |
| 8” | 85-100 |
| 6” | 0-15 |
| 4” | 0-10 |
| 3” | 0 |

Stone shall be graded within the above limits as required to provide a unit weight in-place of 100 pounds per cubic foot or greater.

The Contractor shall provide certification that the material meets the specified gradations.

C. Filter Blanket. Filter blanket may be either of the following types at the Contractor's option:

1. Granular Filter. Granular filter material shall consist of sound, durable rock particles conforming to the following gradation.

| Sieve Size | Cumulative Percent Passing by Weight |
|---|---|
| 1” | 100 |
| ½” | 70-100 |
| No. 4 | 50-85 |
| No. 10 | 35-70 |
| No. 40 | 20-50 |
| No. 100 | 15-40 |

2. Filter Fabric. Filter fabric shall consist of woven or nonwoven fabric. The synthetic fiber of either the woven or nonwoven fabric shall consist of polypropylene, nylon, or polyester filaments. The percent open area shall be not less than 4 percent nor more than 10 percent. The cloth shall provide an Equivalent Opening Size (EOS) no finer than the U.S. Standard Sieve No. 100. In addition, filter fabric shall meet the following physical requirements:

a. Tensile Strength. Minimum grab tensile strength, both warpwise and fillingwise, shall be 200 pounds when tested in accordance with ASTM D 5034, using a four inch (4”) by six inch (6”) specimen and a jaw speed of 12 inches per minute.

b. Elongation. Grab elongation shall be not less than 15 percent nor more than 60 percent, both warpwise and fillingwise, when tested in accordance with ASTM D 5034.

c. Tear Strength. Minimum trapezoid tear strength shall be 100 pounds, both

warpwise and fillingwise. Method of test for woven fabrics shall be in accordance with ASTM D 1117.

d. Bursting Strength. Minimum bursting strength shall be 400 psi when tested in accordance with ASTM D 3887.

e. Seam Strength. Woven fabric shall have a minimum seam-breaking strength of 180 pounds when tested in accordance with ASTM D 1683, using a jaw speed of 12 inches per minute.

f. Width. Filter fabrics shall be furnished in widths of not less than six feet (6').

D. Gabion Baskets. Baskets shall be of the dimensions indicated on the drawings and be fabricated using hexagonal triple-twist wire mesh.

1. Wire. Wire shall be galvanized-steel having a minimum tensile strength of 60,000 psi, and shall be zinc coated in accordance with ASTM A 641 Class 3.

2. Wire Mesh. Maximum dimension of the mesh opening shall be 4 1/2 inches or less, and the maximum area of the mesh opening shall not exceed 12 square inches. Wire shall be 0.1120 inch (minimum) diameter.

3. Selvedge Wire. Selvedge wire shall be 0.1535 inch (minimum) diameter. All perimeter edges of the mesh forming the gabion shall be securely selvedged so that joints formed by tying the selvedges have a strength equal to or greater than the body of the basket.

4. Lacing and Stay Wire. Wire shall be 0.0866-inch diameter or larger. Other connection methods, such as stainless steel clips, may be substituted with approval of the Engineer.

5. Diaphragms. Gabions shall be divided into cells not greater than 4 feet in width by wire mesh diaphragms. Diaphragms shall be factory secured to the base of the basket by continuous spiral wire.

6. PVC (Polyvinyl Chloride Coating): Where specified in the Plans, all wire used in the fabrication of the baskets and in the wiring operations during construction shall, after zinc coating, have an extruded coating of PVC. The coating shall be gray in color ranging between series 26187 and 26293 or between series 26373 and 26375, semi-gloss, as per Federal Standard 595B. The PVC coating shall be nominal thickness of 0.02165 inches and shall nowhere be less than 0.015 inches in thickness. The coating shall be resistant to the destructive effects of immersion in acidic, salt or polluted water, exposure to ultraviolet light, and abrasion and shall retain these characteristics after a period of not less than 3,000 hours under test in accordance with ASTM G 23.

E Grout. Grout shall consist of one part portland cement and five (5) parts aggregate by volume. The aggregate shall be a mixture of crushed stone and clean sand. Uniformly

graded from coarse to fine, and meet the following gradation:

| Sieve Size | Cumulative % Passing |
|---|---|
| 1/2" | 100 |
| No.4 | 40-60 |

Water shall be proportioned to provide a grout having a consistency to permit thorough penetration of the grout into the joints and voids between the stones, but shall not exceed 5.0 gallons per sack of cement. The Contractor may use concrete conforming to MCIB Mix Number A 384- 1/2-2 or A 420 1/2-4 in lieu of the grout here-in-before specified.

4203 CONSTRUCTION DETAILS.

A. Foundation Preparation. After completion of grading in accordance with Section 1100, the area to receive channel lining shall be trimmed and dressed to conform to the cross sections indicated on the drawings within a tolerance of plus or minus two inches (2") from the theoretical slope lines and grades. All deleterious materials shall be removed from the foundation area.

B. Concrete Lining.

1. Preparation. Subgrade shall be moistened by sprinkling. Forms shall be securely staked, braced, and set to line and grade. Reinforcement and tie bars shall be held in position by bar chairs, concrete brick, or other approved devices.

2. Placing and Finishing. Place, consolidate, and strike off concrete to the thickness indicated on the drawings. Concrete shall be tamped or vibrated to eliminate all voids and bring sufficient mortar to the top for finishing. Surface finish shall be a wood-float finish. Round all edges and joints with a 1/4-inch radius edging tool, except contraction joints may be sawed to a depth of 30 percent of the thickness of the concrete lining after concrete has hardened but before uncontrolled cracking occurs. Apply curing membrane as specified in Section 2003.

C. Filter Blanket.

1. Granular Filter. Place granular filter to its full thickness in a single operation. Construction methods shall be such that the material is placed without segregation. Compaction of granular filter material is not required.

2. Filter Fabric. Place filter fabric with its long dimension horizontal and lay free of tension, stress, folds, wrinkles, or creases. Provide 18 inches minimum overlap at each joint and anchor to prevent dislocation during construction of overlaying material.

a. Fabric shall not be left exposed more than two (2) weeks prior to placement of overlaying material. Tracked or wheeled equipment or vehicles shall not be operated on the fabric.

D. Riprap Placement. Riprap shall be placed on the prepared foundation in a manner which will provide a reasonably well-graded mass of stone with the minimum practicable percentage of voids. The entire mass of stone shall be placed so as to be in conformance with the lines, grades, and thicknesses indicated. A filter blanket of filter fabric conforming to Section 4202.C.2 shall be constructed under all riprap. Riprap shall be placed to full-course thickness in one operation and in such a manner as to avoid displacing the fabric.

The Contractor shall place the riprap in such a way as to not tear, puncture, or shift the fabric. Riprap shall not be dropped more than 3 feet when being placed directly on the fabric. Tears or rips in the fabric shall be repaired with fabric lapped a minimum of 12 inches in all directions.

1. Placing. Placing of riprap in layers, or by dumping into chutes, or by similar methods likely to cause segregation will not be permitted.

2. Distributing. The larger stones shall be well distributed and the entire mass of stone shall conform to the specified gradation. All material shall be so placed and distributed that there will be no objectionable accumulations of either the larger or smaller sizes of stone.

3. Hand Placing. It is the intent of these specifications to produce a fairly compact riprap protection in which all sizes of material are placed in their proper proportions. Hand placing or rearranging of individual stones by mechanical equipment may be required to the extent necessary to secure the specified results.

E. Grouted Stone Lining. Place stone and grout in a manner to produce a securely bound solid mass with the stone interstices completely filled. Sweep the surface clean of all surplus grout with a stiff broom. Apply curing membrane as specified in Section 2003.

F. Gabion Baskets.

1. Assembly. Assemble each gabion unit by binding all vertical edges together with a continuous piece of connecting wire stitched around the vertical edge with coils spaced at three inches (3") or less. Set empty units to line and grade and join units by stitching with connecting wire along adjoining edges. Install and securely fasten internal tie wires in each cell if necessary to retain the shape of the cell during filling operations.

2. Filling. Fill gabion cells with stone carefully by hand or machine to provide a minimum of voids and avoid bulges and distortions of the gabion. After filling, secure the lid to the sides, ends, and diaphragm by stitching with connecting wire.

3. Filter Fabric/Gabion Unit Placement: A filter blanket of filter fabric conforming to

Section 4202.C.2 shall be constructed under all Gabion Baskets. The Contractor shall place the gabions in such a way as to avoid tearing, puncturing, or shifting the fabric. Tears or rips in the fabric shall be repaired with fabric lapped a minimum of 12 inches in all directions.

G. Sod: Sod shall be installed as specified in Section 8202 of Seeding and, except all sod placed in drainage channels or ditches, including both the side slopes and bottom, shall be anchored in accordance with Section 803 of Missouri Standard Specifications for Highway Construction.

## 4204 MEASUREMENT AND PAYMENT

A. Measurement. The quantities of accepted work will be measured in the following units. All measurements will be plan measure except for authorized changes.

1. Pipe. By the linear foot of each size and type. Measurement will be to the nearest 0.1 foot for each line between structures, and made to the inside face of the connecting structure. Precast or refabricated end sections will be excluded from the pipe measurement. Excavation, bedding and backfill shall be included in the cost per linear foot of pipe per each size and type.

2. Prefabricated or Precast End Sections. By the number of each size and type.

3. Concrete Box Culverts. By the linear foot of each size and type. Measurement will be along the center line of the culvert between the back faces of the headwalls. Headwalls will be measured separately as "Structures".

4. Structure. Inlets, manholes, headwalls, end walls, curb inlets, field inlets, and other similar structures will be measured by the number of each size and type as listed in the Contract Documents.

5. Pipe Encasement. Pipe encasement will be measured by the linear foot of each size and type.

6. Concrete Channel Lining: By the square yards of surface area. Measurement will be parallel to sloping surfaces.

7. Filter Blanket. Unless otherwise stated in the Agreement, there will be no separate measurement of payment for filter blanket. All costs for such work shall be included in the price of the related item.

8. Riprap. By the square yard of surface area per each size and depth as specified on the Plans or Standard Drawings. Measurement will be parallel to sloping surfaces. The thickness of the riprap shall conform to the plan dimension. Measurement and payment of the filter fabric shall be included in the cost per square yard of the riprap.

9. Gabion Baskets. By the cubic yard on the basis of Plan dimensions.

10. Sodding. Measurement shall be per square yard. Areas that are disturbed which lie outside the construction limits, as defined by the Plans, will not be measured for payment, but shall be restored to a condition equal to or better than that existing prior to construction. For lined (riprap or concrete) channels, sod placement and /or repairs shall be incidental to the cost of placement of the lining material.

11. Seeding. Measurement shall be per square yard. Areas that are disturbed which lie outside the construction limits, as defined by the Plans, will not be measured for payment, but shall be restored to a condition equal to or better than that existing prior to construction. For lined (riprap or concrete) channels, sod placement and /or repairs shall be incidental to the cost of placement of the lining material.

B. Payment. Payment will be made at the respective unit or lump sum price listed in the Contract Documents, and shall be full compensation for all labor, materials, and equipment necessary to complete the respective unit in place. There will be no separate measurement or payment for any item of work not specifically identified and listed in the contract documents, and all such work shall be considered a subsidiary item with all costs pertaining thereto included in the prices for other items listed in the contract documents.

SECTION 4300 STORMWATER DETENTION REQUIREMENTS

4301 GENERAL Detention may be accomplished in nearly any method viable on the project site. This can include detention ponds, tanks, below ground systems or even parking lot or landscape island detention.

A. Discharge may be by use of V-notch walls or small pipe. Innovative solutions are usually acceptable depending upon City staff review.

B. Open basins must be soil lined and have soil placed on interior and exterior side slopes. Soil must be seeded and mulched.

C. Rip rap or rock lined basins and berms will only be allowable under unusual circumstances and with special permission from the Director of Public Works/Engineering.

4302 RATE OF RUN-OFF

A. Stormwater shall be retained such that the rate of run-off leaving the post-developed site is no greater than the pre-development run-off rate. The difference between the two runoff rates is the amount that should be detained.

B. Detention facilities shall be designed in accordance with the City of Branson Design Criteria for Public Improvement Projects.

C. Discharge velocities must not be erosive. The following channel linings are required:

| VELOCITY | LINING TYPE |
|---|---|
| < 3 fps | Seeded |
| 3 to 5 fps | Sod, staked |
| 5 to 10 fps | Stone Riprap/Shot Rock (12-15" Diameter) |
| 10 to 15 fps | Grouted stone riprap, gabion revetment or concrete |
| Over 15 fps | Concrete paved or sound in-situ rock |

Velocities must be reduced prior to exiting the appropriate lining.

4303 REQUIREMENTS

All storm sewers under street pavement must be concrete unless a specific waiver is granted from the Director of Public Works/Engineering. Flared end-sections are required on all CMP and RCP and concrete aprons, wing walls and toe walls are required on all concrete box culverts.

Any disturbance of land over 1 acre in size requires a permit from the Missouri Department of Natural Resources. A sediment and erosion control plan must be developed, implemented and phased prior to beginning any land disturbance. The plan can include such items as silt socks, silt fencing, staked straw bales, diversion berms or silt retention ponds to control the run-off during the construction.

Drainage easements must be dedicated to the City where appropriate.

## 4304 MAINTENANCE OF DETENTION FACILITIES

The maintenance responsibility for all elements of the detention facility should be designated prior to construction of any detention facility. However, when no designation is made the property owner shall be considered the responsible party. Annual or more frequent inspections shall be made by the responsible party to assure that all inlet and outlet structures are full functional and the detention basin has full storage capacity. Where a basin serves more than one property owner, such as a subdivision, the maintenance requirement shall be vested with a property owner's association.

Maintenance shall include mowing, the removal of silt, debris, and restrictive vegetation, from the basin and control structure in order to maintain full operational capacity.

# 4400 SEDIMENT AND EROSION CONTROL

4401 SCOPE. The purpose of these technical specifications is to prevent or minimize sediment and debris from leaving disturbed lands within the City of Branson by implementing Best Management Practices (BMPs) to promote a cleaner environment and healthier community. The requirements set forth in these specifications apply to any permitted land disturbance activities inside Branson city limits or other activities adversely affecting Branson's MS4 (Municipal Separate Storm Sewer System).

4402 GENERAL CRITERIA. General criteria described in the city's Design Criteria for Public Improvement Projects document should be reviewed prior to the start of any land disturbance activities.

## 4500 BEST MANAGEMENT PRACTICES (BMPS)

4501 GENERAL. This section contains a list of the most commonly implemented BMPs used for sediment and erosion control along with their respective technical specifications. While this list contains several regularly used methods, sediment control measures are not limited to the following list. New and creative ways to control sedimentation and erosion are encouraged but require approval from required personnel from the City of Branson. Almost all BMPs require some form of routine maintenance to ensure effectiveness, for this reason a maintenance section has been added to each BMP below. It should be known that all deficiencies found must be repaired within 7 days of discovery and all temporary BMPs must remain in place until land disturbance ceases.

4502 TEMPORARY CONTRUCTION ENTRANCE/EXIT. Prior to any vehicles or equipment accessing unpaved areas, a stabilized temporary entrance should be designed to minimize the amount of sediment that leaves the construction site on vehicles and equipment. Mud, sediment, and debris fall from tires as they bounce along the stabilized entrance. Optimally, only one temporary entrance/exit will be constructed; for larger projects, each area where vehicles and equipment will be leaving the construction site will need a temporary entrance/exit. All employees, subcontractors, suppliers, and any other personnel leaving the facility must use the designated entrance/exit.

1. Geotextiles. At a depth of at least 6", geotextiles meeting the physical and chemical requirements of AASHTO M 288 or equivalent should be placed for stability and longevity of the entrance.

2. Riprap. Crushed aggregate of 3"-6" should be placed on top of the geotextile until a depth of at least 6" of rock has been achieved.

3. The entrance should be a minimum of 50' long. The addition of a culvert under the entrance may be necessary to maintain positive drainage. A section of corrugated steel panel has been used to increase the removal of mud, rock, and debris from vehicles, but is not required.

4. Maintenance. Temporary entrances should be inspected weekly and within 48 hours of a rain event totaling 1" or more within a 24-hour period. Continuously remove sediment and clods of dirt from the construction entrance. Replace rock to maintain a depth of at Least 6". Sometimes fluffing of the rock is sufficient to maintain effectiveness of the entrance; this can be done by taking the bucket, or other implement from the on-site equipment and raking the aggregate to increase the ability of the rock to remove debris. Any sediment or debris in the roadway should be removed immediately.

4503 SEDIMENT BASIN. Sediment basins are temporary settling ponds designed to release runoff slowly, detaining it long enough to allow most of the sediment to settle out. These basins need to be in place before clearing and grubbing operations begin and should remain in place until final stabilization has been achieved. Typically, sediment basins are used in conjunction with other BMPs to reduce the amount of sediment that enters the basin. Sediment basins should not be used in streams

regulated by the US Army Corps of Engineers under section 404 of the Clean Water Act or areas where dam failure would result in loss of life and/or property damage.

A. Installation Specifications. Sediment basins will be unique to a project or area and must be designed by a qualified professional engineer who is experienced in designing dams. Basin length, width, depths and slopes should be defined on plans. Place and compact fill to construct dam elevation to at least 1 foot above crown of the outlet pipe. Clayey soil should be compacted around the outlet pipe. The perforated riser pipe should be installed, wrapped with fabric, and surrounded uniformly with graded gravel. The spillway should be graded and stabilized. A monitoring post should be installed near the outlet of the basin and the maximum allowable sediment depth should be marked. Install and appropriate BMP at the downstream end of the outlet pipe.

B. Maintenance. Sediment Basins should be inspected weekly and within 48 hours of a rain event totaling 1" or more within a 24-hour period. Remove any accumulation of trash. Remove all sediment once the accumulation reaches design depth. Repair and/or vegetate any erosion damage.

4504 COMPOST FILTER SOCK. A compost filter sock is a type of compost filter berm consisting of a mesh tube filled with composted material. Typically, compost filter socks are used to control sheet flow runoff but can also be used for some small sheet flows.

A. Technical Specifications. For perimeter protection, the contributing drainage area should not exceed 0.25 acres for every 100-foot of sock. The diameter of compost filter sock will vary based on the steepness and length of slope. Typically, sock of 12-inches in diameter is used for perimeter control, though sometimes 8, 18, and 24-inch diameters are used.

B. Stakes. Filter Socks should be staked with 2" X 2" X 36" construction grade wood stakes and with stake spacing no more than 10' between each stake. Must be driven in the ground to a minimum of 18", in areas where rock is encountered posts shall be installed in a manner approved by the engineer.

C. Maintenance. Compost filter socks should be inspected weekly and within 48 hours of a rain event totaling 1" or more within a 24-hour period. Sediment should be removed when it reaches a height of ½ the height of the filter sock. Replace any broken sections of sock or posts.

4505 FIBER ROLLS/WATTLES. Wattle products are tubes of open weave containment material filled with straw, rice or wheat straw, excelsior, coir, or compost material. They come in a variety of diameters and lengths and can be used for sheet or concentrated flows.

A. Materials. Each Wattle should be wrapped with UV-degradable polypropylene netting for or with 100 percent biodegradable materials like burlap, jute, or coir.

B. Stakes. Wattle products should be staked with 2" X 2" X 36" construction grade wood stakes and with stake spacing no more than 10' apart for sheet flows. For concentrated flows, stake

spacing should be no further than 4’ apart. Must be driven in the ground to a minimum of 18”, in areas where rock is encountered posts shall be installed in a manner approved by the engineer.

C. Size and Weight. Wattle products should weigh 3 pounds per linear foot for a 12-inch diameter and 5 pounds per linear foot for an 18-inch diameter.

D. Spacing. For larger areas and/or steeper slopes, several rows of wattles should be added to slow the flow of water and reduce erosion. The vertical spacing should be determined based on the slope gradient and soil type. A good rule of thumb is: 1:1 slopes=10 feet apart, 2:1 slopes=20 feet apart, 3:1 slopes=30 feet apart, 4:1 slopes=40 feet apart. Follow the manufacturers recommendations and specifications when installing wattle products. Installation should occur immediately after rough grading and prior to seeding or mulching.

E. Maintenance. Fiber rolls should be inspected weekly and within 48 hours of a rain event totaling 1” or more within a 24-hour period. Sediment should be removed when it reaches a height of ½ the height of the wattle. Replace or repair any deficient sections or stakes.

4506 CHECK DAM. Check dams, also called ditch checks, are temporary or permanent linear obstructions placed in a drainage way and control sedimentation and erosion by slowing the velocities of stormwater runoff. Two main types of check dams exist, rock check dams and alternative.

A. ROCK CHECK DAMS. Rock check dams are the primary type of check dam used.

1. Dimensions and Spacing. Dam should be 1’-3’ of crushed aggregate at the lowest point. The aggregate should be 2”-3” washed stone. The dam should have a level center section with a 6”-12” rise on both sides to cause flow over the dam and not around. The dam should have an apron on the downstream side that is approximately 6” in depth and twice as long as the dam is tall. Check dams should be spaced so that the elevation of the toe must be the same or less than the elevation of the top of the next dam. The first dam should be installed approximately 5 meters from the outfall device.

2. Geotextiles. If geotextile fabric is necessary, it should meet the physical and chemical requirements of AASHTO M 288.

B. ALTERNATE CHECK DAMS. Alternate check dams are included but are not limited to triangular silt checks, filter socks/logs, and sandbags. Check dams **should not** be constructed with straw bales or straw wattles.

1. Dimensions and Spacing. Alternate check dams have a minimum effective height of 9 inches, as measured in the field and should be used where drainage area is 3 acres or less. Alternate check dams should not be used where slopes are greater than 4

percent. Check dams should be spaced so that the elevation of the toe must be the same or less than the elevation of the top of the next dam. The first dam should be installed approximately 5 meters from the outfall device.

C. Maintenance for Rock and Alternate Check Dams. Dams should be inspected at least once a week and within 48 hours after a rain event totaling 1" in 24-hours. Remove any trash and/or leaf accumulation. Sediment should be removed when the depth reaches ½ the height of the dam. Repair the stone or alternate structure when necessary to keep the original design and effectiveness.

4507 STRAW BALES. When installed correctly, straw bales can be used for temporary barriers along the slope or perimeter of a construction site to intercept, detain, and filter sediment transported by stormwater runoff. Straw bales **should not** be used to control concentrated flow.

A. Stakes. Construction grade wooden stakes 2" x 2" x 36" shall be wrapped in geotextile, entrenched, and then driven in the ground. 1.0 lb./linear foot steel may also be used as stakes. Stakes must be driven a minimum of 18 inches into the ground, in areas where rock is encountered posts shall be installed in a manner approved by the engineer.

B. Placement and Spacing. Straw bales should be entrenched to a depth of at least 6 inches. Bales should be placed on their side so that the twine does not come in contact with the ground. Any open space between straw bales in a barrier must be filled with excess straw material. Straw bale barriers should be used for sheet flows less than ¼ acre per 100 linear feet of barrier. For slopes with grades steeper than 7 percent, straw bale barriers should be placed 5 to 7 feet from the base of the slope. The typical life span of a straw bale is 3 months, and the absolute maximum lifespan is 6 months.

C. Maintenance. Straw bales should be inspected at least once a week and within 48 hours after a rain event totaling 1" in 24-hours. Remove any trash accumulation. Sediment should be removed when the depth reaches ½ the height of the bale. Replace bales when damaged or deficient.

4508 TURF REINFORECMENT MATS (TRMS). Permanent synthetic erosion control blankets that resist erosion and reinforce the root zone for vegetation. TRMs increase the ability of vegetation to resist the erosive force of flowing water.

A. Technical Specifications. Most slopes steeper than 3:1 should use TRMs or another type of rolled erosion control product. TRMs should be used in channels where flow velocity ranges from 10-20 ft./s or the shear stress ranges from 4-10 lbs./$ft^2$.The quality of TRM should at least meet the specifications of Landlok 450. If the flow velocity is greater than 20 ft./s, other or additional BMPs should be used, such as riprap. Turf reinforcement mats should be installed per the manufacturer's recommendations.

B. Maintenance. TRMs may initially require regular watering after installation if there has not been sufficient rainfall for root growth. Must be inspected weekly and after a rain event totaling 1" or more within a 24-hour period. All deficiencies must be repaired and/or replaced.

4509 SURFACE ROUGHENING. Surface roughening involves several types of horizontal depressions meant to aid in the establishment of vegetation, reduce runoff volume, reduce runoff velocity, increase infiltration, reduce erosion, and provide for sediment trapping. Surface roughening is appropriate for all slopes but works especially well on slopes steeper than 3H:1V and areas with highly erodible soils. There are three main methods of surface roughening: tracking, grooving, and stair-stepping.

A. Tracking. Tracking is accomplished by tracking equipment vertically up and down slopes to create **horizontal** depressions, which are perpendicular to the flow path. Since tracking compresses the soil, it is typically recommended for sandy soil so that the compression does not inhibit root production.

B. Grooving. Groves created by a series of ridges and depressions that run along the contour of a slope. Groves can be created with any implement capable of creating groves no more than 3 inches deep and no more than 15 inches apart.

C. Stair-stepping. Stair-stepping is the construction of earthen stair steps along a steep slope. Stairs should be constructed with a vertical rise of no more than 1 foot and horizontal runs that are longer than the vertical rise. Horizontal runs should be sloped inward toward the vertical step face.

D. Maintenance. Slopes where surface roughening was employed should be inspected at least once a week and within 48 hours after a rain event totaling 1" in 24-hours. Some larger rain events may cause small rills to form; if rills or other forms or erosion are present, the slope should be reworked as soon as practicable.

4510 GEOTEXTILES. A woven or non-woven water permeable material used primarily for filtration, drainage, separation, reinforcement, and stabilization purposes. Geotextiles are integral components of several BMPs such as sediment fence, construction entrances, and check dams.

A. Technical Requirements. Any geotextile must meet the physical and chemical requirements of AASHTO M 288. Fibers used in the manufacture of geotextiles and the threads used in joining geotextiles by sewing, must consist of long-chain synthetic polymers, composed of at least 95 percent by weight of polyolefins or polyesters. Fibers shall be formed into a stable network such that the filaments or yarns retain their dimensional stability relative to each other, including selvages.

B. Quality Control. The condition of all geotextiles shall be reviewed for damages that may have occurred during shipping/transport. The contractor must provide the engineer with a certificate stating the name of the manufacturer, product name, style number, chemical composition of the filaments or yarns, and other pertinent information to fully describe the

geotextile. The manufacturer is responsible for establishing and maintaining a quality control program to ensure compliance with the requirements of the specification. Documentation describing the quality control program shall be made available upon request. Any geotextile material may be sampled and tested by the inspector at their discretion to determine if the material is in compliance. Geotextiles have a typical lifespan of 6 months.

C. Maintenance. Geotextiles should be inspected at least once a week and within 48 hours after a rain event totaling 1" in 24-hours. Look for rips, tears, and damage from UV exposure. All sections falling short of AASHTO M 288 requirements should be replaced as soon as practicable.

4511 SEDIMENT FENCE. Sediment fences are temporary sediment barriers consisting of synthetic fabric stretched across and attached to supporting posts and entrenched or sliced in place for the purpose of removing suspended particles from the water passing through the fence. Sediment fence should only be used as perimeter control sheet flows and should never be used to control concentrated flow. The use of sediment fence is limited to ¼ acre per 100 feet of fence and must be installed by a qualified professional prior to any land disturbance activities

A. Stakes. Construction grade wooden stakes 2" x 2" x 36" shall be wrapped in geotextile, entrenched, and then driven in the ground. 1.0 lb./linear foot steel may also be used as stakes. Stakes must be driven a minimum of 24 inches into the ground, in areas where rock is encountered posts shall be installed in a manner approved by the engineer. For sediment fences supported with wire backing, 4-inch diameter wood or 1.33lb./linear foot steel must be used. Spacing of support posts should be not more than 10' between posts with wire support and 5' between posts without wire support.

B. Geotextiles. Geotextiles must meet the physical and chemical requirements of AASHTO M 288. The fence must be entrenched to a depth of at least 6 inches, the trench shall be backfilled and compacted over the geotextile.

C. Maintenance. Sediment fencing should be inspected at least once a week and within 48 hours after a rain event totaling 1" in 24-hours. Look for rips, tears, and damage from UV exposure in geotextile material - all sections falling short of AASHTO M 288 requirements should be replaced as soon as practicable. Broken or damaged posts should also be replaced.

4512 TACKIFIERS. Chemical compounds sprayed onto a soil surface to bind soil particles and prevent erosion.

A. Technical Specifications. Application of liquid mulch binders and tackifiers should be heaviest at the edges of areas and at crests of ridges and banks. Binder should be applied uniformly to the rest of the area. Many different chemical compounds for tackifiers exist. This product should be used on organic mulch and should only be used to control sheet flow.

B. Maintenance. Any slope where a tackifier was used should be inspected at least once a week and within 48 hours after a rain event totaling 1" in 24-hours.

4513 ROLLED EROSION CONTROL PRODUCTS (RECPS). Protective blankets of plastic fibers, straw, or other plant matter, which are installed on a steep slope, channel or shoreline to protect soil from overland flow, erosion from precipitation, and retain moisture to facilitate plant growth.

A. Technical Specifications. All RECPs shall be categorized based on performance testing for the C-factor by ASTM D6459 and physical testing for the minimum tensile strength by ASTM D5035. All products shall meet the requirements described in Sec 1011 of *Missouri Standard Specifications for Highway Construction.*

B. Maintenance. Any disturbed area where a rolled erosion product is utilized should be inspected at least once a week and within 48 hours after a rain event totaling 1" in 24-hours.

4514 VEGETATED FILTER STRIP. A vegetated filter strip is a buffer of existing or installed vegetation that can be left downhill from land disturbance activities to provide sediment control in place of or in addition to other BMP controls. Vegetated filter strips are used when sheet flow is present.

A. Technical Specifications. The length of the vegetated filter strip should be no less than 25 feet. If there is a permeable berm at the lower end, the length of the vegetated filter strip area should be no less than 15 feet. Permeable berms should be constructed with of well-drained soils (sand, gravels, and sandy loams) that support plant growth and should be no more than 12" high. If sheet flow is not present, a level spreader or velocity dissipater must be used. A level spreader should be 12" to 18" wide and 6" to 12" deep trench filled with pea gravel or ASTM No. 8 stone along a level contour (larger stone may be needed for larger impervious drainage surfaces). The area of impervious drainage to any one discharge location cannot exceed 5,000 $ft^2$. No land disturbance activities should occur within the drip line of existing vegetative filter strip.

B. Maintenance. Vegetated filter strips should be maintained so that they continue to provide measurable stormwater management benefits over time. This may include periodic watering, especially if the filter was installed rather than existing vegetation. Vegetation buffers should be inspected at least once a week and within 48 hours after a rain event totaling 1" in 24-hours. All trash and debris accumulation should be removed, and deficiencies improved.

4515 VELOCITY DISIPATION DEVICES. These devices are placed at pipe outlets and other concentrated outflow locations to reduce the flow velocity, further reducing the erosive properties of high velocity flows.

A. Velocity Ranges. Velocity dissipation devices should be used for flow velocities between the ranges of 20 to 33 ft./s and discharges of up to 400 cfs. If outlet velocities are greater than 33 ft./s and/or discharges are 400 cfs, consideration should be given to modifying the design to reduce the outlet velocity.

B. Riprap Apron. One of the most effective dissipation devices is the use of a riprap apron. This apron shall consist of geotextile material keyed into a depth of 6" to 9" with riprap placed carefully on top so as to not compromise the structural integrity of the fabric. Geotextiles

must meet the physical and chemical requirements of AASHTO M 288. Apron must meet the requirements of the following table.

| Discharge (cfs) | Apron Length | Riprap Minimum Diameter |
|---|---|---|
| 5-10 | 13 | 6 |
| 10-20 | 16 | 8 |
| 20-30 | 23 | 12 |
| 30-60 | 30 | 16 |

For discharges greater than 60 cfs, Apron length and riprap diameter shall be approved by a qualified engineer with expertise in storm water velocity dissipation devices.

C. Maintenance. All velocity dissipation devices should be inspected at least once a week and within 48 hours after a rain event totaling 1" in 24-hours. All trash and debris accumulation should be removed, and deficiencies improved.

## 4530 CONCRETE WASHOUT

4531 GENERAL The management of concrete waste prevents the discharge of pollutants to stormwater conducting washout off-site, performing on-site washout in a designated area, and training employees and subcontractors. Concrete washout stations should be stalled before the start of any concrete activities or deliveries.

### 4532 SPECIFICATIONS

Location. Washout stations should be located at least 50' from the nearest storm drains, open drainage facilities, and watercourses.

Lining. Plastic lining material should be a minimum of 10-millimeter polyethylene sheeting and should be free from holes, tears, or other defects that compromise the impermeability of the material.

Maintenance. Concrete washout stations should be inspected at least once a week and within 48 hours after a rain event totaling 1" in 24-hours. Remove and dispose of hardened concrete and return the facility to a functional condition. Facilities must be cleaned, or new facilities constructed and ready for use when the washout is 75% full.

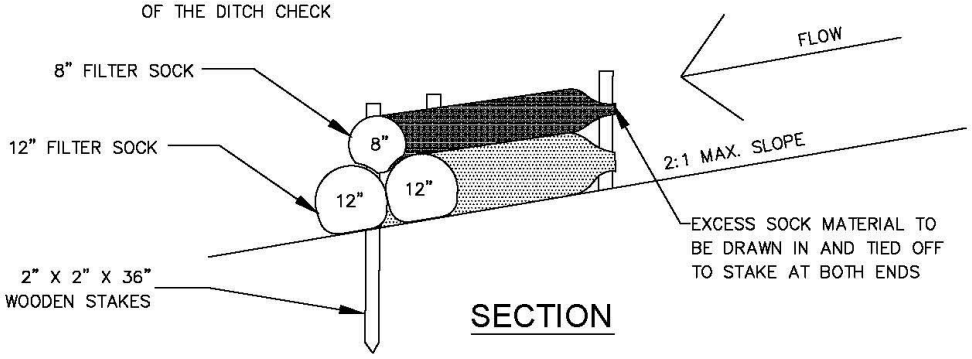
## 4550 SELF-PERFORMED BMP INSPECTIONS.

4551 GENERAL. As mentioned in the previous sections, routine maintenance is one of the easiest ways to minimize erosion and control stormwater runoff on any disturbed site. These inspections should be performed at a minimum of once weekly **and** no more than 48-hours after any rain event totaling 1" or more within a 24-hour time span. For accountability and record-keeping purposes, these inspections are required to be sent to the city for all permitted land disturbances.

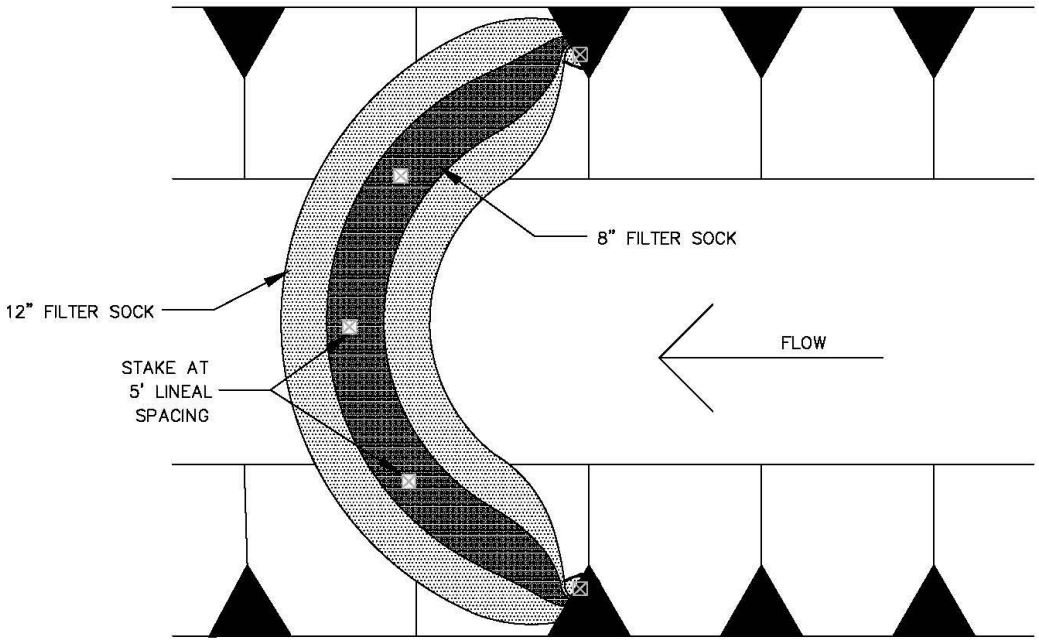
## NOTES:

1. COMPOST FILTER SOCK SHALL MEET THE REQUIREMENTS OF MoDOT SECTION 806.8.6.4.8. CONTRACTOR SHALL SUBMIT SHOP DRAWINGS TO ENGINEER FOR APPROVAL BEFORE INSTALLING SOCK.
2. FILTER SOCK DEPICTED IS FOR MINIMUM SLOPES. GREATER SLOPES MAY REQUIRE LARGER SOCKS PER ENGINEER.
3. COMPOST MATERIAL TO BE DISPERSED ON SITE, AS DETERMINED BY ENGINEER.

ONCE THE ACCUMULATED HEIGHT HAS REACHED 1/2 THE HEIGHT OF THE DITCH CHECK




SECTION




PLAN

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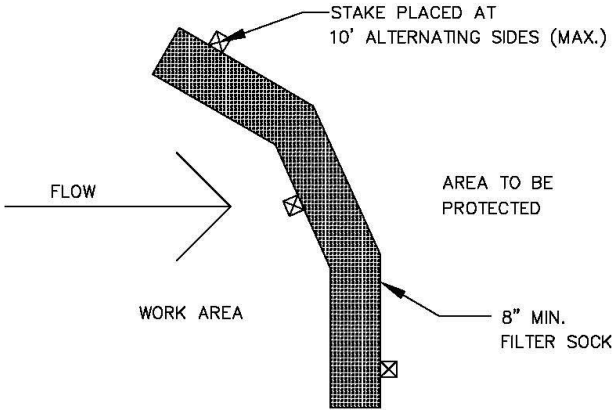
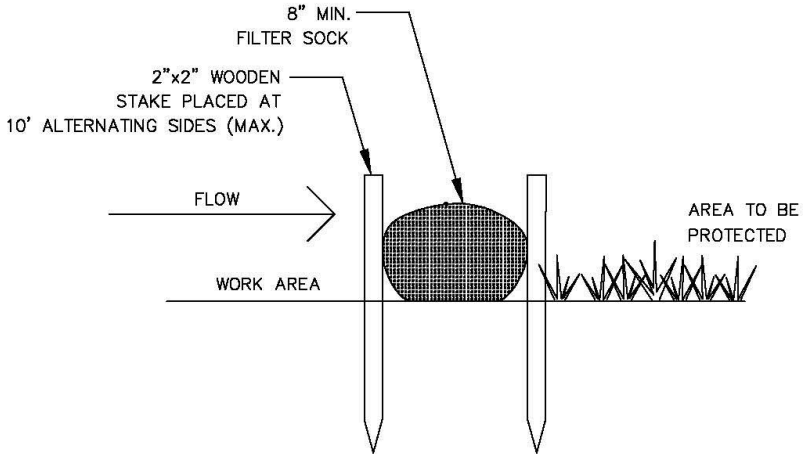
| Branson MISSOURI Engineering & Public Works | COMPOST FILTER SOCK DITCH CHECK DETAILS | STANDARD DRAWING 45-1 | |
| | | ADOPTED 2023 | REVISION |




PLAN VIEW




SECTION VIEW

## NOTES:

1. COMPOST FILTER SOCK SHALL MEET THE REQUIREMENTS OF MoDOT SECTION 806.8.6.4.8. CONTRACTOR SHALL SUBMIT SHOP DRAWINGS TO ENGINEER FOR APPROVAL BEFORE INSTALLING SOCK.
2. FILTER SOCK DEPICTED IS FOR MINIMUM SLOPES. GREATER SLOPES MAY REQUIRE LARGER SOCKS PER ENGINEER.
3. COMPOST MATERIAL TO BE DISPERSED ON SITE, AS DETERMINED BY ENGINEER.

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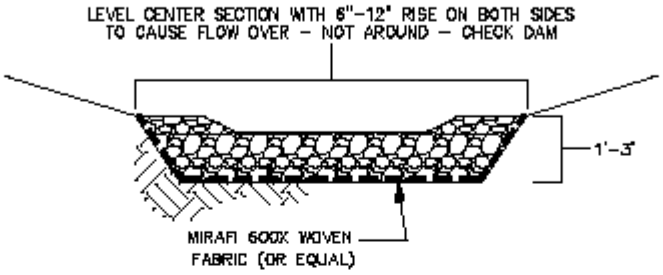
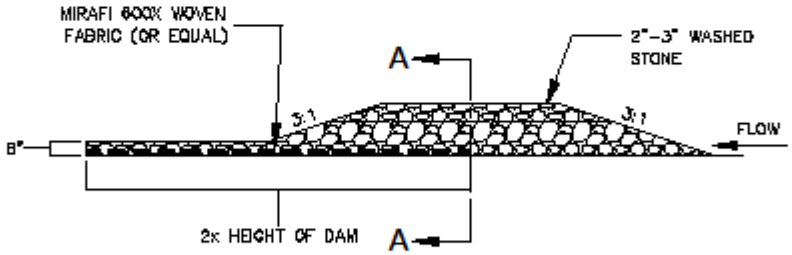
| Branson MISSOURI ★ Engineering & Public Works | COMPOST FILTER SOCK FOR SHEET FLOW DETAILS | STANDARD DRAWING 45-2 | |
| | | ADOPTED 2023 | REVISION |




SECTION A-A




PROFILE

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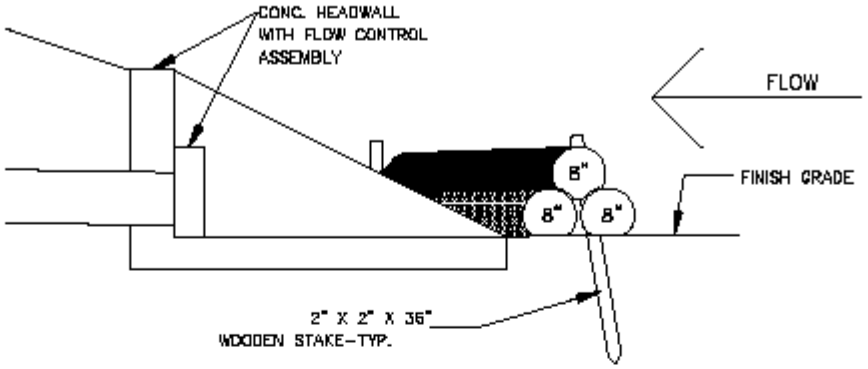
| Branson Missouri Engineering & Public Works | ROCK DITCH CHECK DETAILS | STANDARD DRAWING 1-3 | |
| | | ADOPTED 2023 | REVISION |

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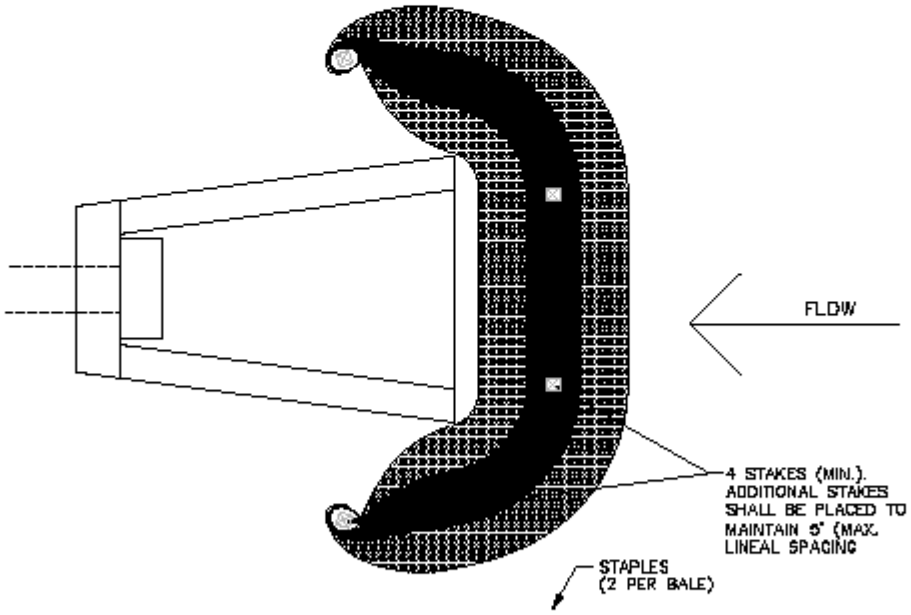


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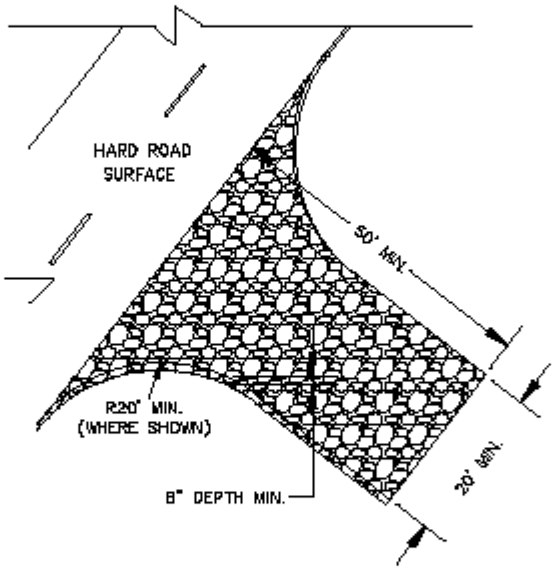
| Branson Missouri Engineering & Public Works | HEADWALL INLET PROTECTION DETAILS | STANDARD DRAWING 1-4 |
| | | ADOPTED 2023 / REVISION |

NOTES:

1. INSTALL AS SOON AS POSSIBLE BEFORE START OF GRADING
2. PLACE FILTER FABRIC UNDER STONE
3. USE 3"-6" CLEAN CRUSHED LIMESTONE
4. REPLACE AS NEEDED TO MAINTAIN 6" DEPTH

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| Branson Missouri Engineering & Public Works | GRAVEL CONSTRUCTION ENTRANCE / EXIT | STANDARD DRAWING 1-5 | |
| | | ADOPTED 2023 | REVISION |

## EROSION CONTROL NOTES:

1. THE CONTRACTOR SHALL BE RESPONSIBLE FOR MAINTENANCE OF ALL EROSION & SEDIMENT CONTROL MEASURES AND PRACTICES THROUGHOUT THE PROJECT. ANY AND ALL FINES ASSOCIATED WITH EROSION CONTROL VIOLATIONS WILL BE THE CONTRACTOR'S RESPONSIBILITY.

2. EROSION CONTROL IS THE CONTRACTOR'S RESPONSIBILITY. THIS PLAN SHOULD BE USED AS A GUIDE AND REPRESENTS THE MINIMUM EROSION CONTROL DEVICES REQUIRED.

3. EROSION CONTROL MEASURES WILL BE MAINTAINED AT ALL TIMES. ADDITIONAL EROSION & SEDIMENT CONTROL MEASURES WILL BE INSTALLED IF DEEMED NECESSARY BY ON-SITE INSPECTION.

4. CONTRACTOR IS RESPONSIBLE FOR REPAIRING ALL EROSION & SEDIMENT CONTROL DEVICES AFTER EACH RAINFALL EVENT.

5. THE CONTRACTOR SHALL PROVIDE ANY FURTHER EROSION CONTROL MEASURES IN ADDITION TO THOSE LISTED TO ENSURE THAT SILT WILL NOT LEAVE THE PROJECT CONFINES.

6. THE CONTRACTOR IS RESPONSIBLE FOR REMOVING THE TEMPORARY EROSION & SEDIMENT CONTROL DEVICES AFTER COMPLETION OF CONSTRUCTION AND ONLY WHEN AREAS HAVE BEEN STABILIZED WITH A HEALTHY STAND OF PERMANENT VEGETATION.

7. THE CONTRACTOR IS RESPONSIBLE FOR REMOVING SILT FROM SITE IF NOT REUSABLE ON-SITE AND ASSURING PLAN ALIGNMENT AND GRADE IN ALL DITCHES AT COMPLETION OF CONSTRUCTION.

8. THE CONTRACTOR SHALL ENSURE THAT ALL DRAINAGE STRUCTURES, FLUMES, PIPES, ETC. ARE CLEANED OUT AND WORKING PROPERLY AT TIME OF ACCEPTANCE.

9. THE CONTRACTOR SHALL PROVIDE ANY TEMPORARY STABILIZATION AS REQUIRED.

10. THE CONTRACTOR SHALL PROVIDE A TEMPORARY CONSTRUCTION ENTRANCE FOR VEHICULAR TRAFFIC AT LOCATION SHOWN.

11. ALL EROSION CONTROL DEVICES SHALL CONFORM TO THE APPLICABLE SECTIONS OF THE STANDARD SPECIFICATIONS AND DESIGN CRITERIA OF THE CITY OF BRANSON.

12. THE CONTRACTOR WILL BE REQUIRED TO CLEAN THE STREETS OF DEPOSITED MUD AS FREQUENTLY AS NEEDED AS DETERMINED BY THE ENGINEER IN ORDER TO KEEP THEM USABLE AND TO CONTROL DUST.

13. SEE TEMPORARY VEGETATION REQUIREMENT NOTES ON THIS SHEET FOR EXPOSED SOIL WHERE NO ACTIVITY WILL OCCUR FOR MORE THAN 14 DAYS.

14. CONTRACTOR IS RESPONSIBLE FOR PHASED INSTALLATION OF EROSION CONTROL BMP'S IN ORDER TO PREVENT SEDIMENT FROM BREACHING THE LIMITS OF DISTURBANCE.

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| Branson MISSOURI Engineering & Public Works | EROSION CONTROL NOTES | STANDARD DRAWING 1-6 | |
| | | ADOPTED 2023 | REVISION |

1. HANDLING AND DISPOSAL OF HAZARDOUS MATERIALS:

SHALL: PREVENT SPILLS
USE PRODUCTS UP
FOLLOW LABEL DIRECTIONS FOR DISPOSAL
REMOVE LIDS FROM EMPTY BOTTLES AND CANS WHEN DISPOSING TRASH
RECYCLE WASTES WHENEVER POSSIBLE

SHALL NOT: POUR WASTE INTO SEWERS OR WATERWAYS ON THE GROUND
POUR WASTE DOWN THE SINK, FLOOR DRAIN OR SEPTIC TANKS
BURY CHEMICALS OR CONTAINERS, OR DISPOSE OF THEM WITH OTHER WASTE
BURN OR MIX CHEMICALS OR CONTAINERS
WASH SEDIMENT DOWN STORM SEWER INLETS

2. CONTAINERS SHALL BE PROVIDED FOR COLLECTION OF ALL WASTE MATERIAL INCLUDING CONSTRUCTION DEBRIS, TRASH, PETROLEUM PRODUCTS AND ANY HAZARDOUS MATERIALS TO BE USED ONSITE. ALL WASTE MATERIAL SHALL BE DISPOSED OF AT FACILITIES APPROVED FOR THAT MATERIAL.

3. NO WASTE MATERIALS SHALL BE BURIED ON-SITE.

4. MIXING, PUMPING, TRANSFERRING OR OTHERWISE HANDLING CONSTRUCTION CHEMICALS SUCH AS FERTILIZER, LIME, ASPHALT, CONCRETE DRYING COMPOUNDS, AND ALL OTHER POTENTIALLY HAZARDOUS MATERIALS SHALL BE PERFORMED IN AN AREA AWAY FROM ANY WATERCOURSE, DITCH OR STORM DRAIN.

5. EQUIPMENT FUELING AND MAINTENANCE, OIL CHANGING, ETC., SHALL BE PERFORMED ONLY IN AN AREA DESIGNATED FOR THAT PURPOSE. THE DESIGNATED AREA SHALL BE EQUIPPED FOR RECYCLING OIL AND CATCHING SPILLS.

6. CONCRETE WASH WATER SHALL NOT BE ALLOWED TO FLOW DIRECTLY TO STORM SEWERS, STREAMS, DITCHES, LAKES, ETC WITHOUT BEING TREATED. A CONCRETE WASHOUT AREA SHALL BE PROVIDED. SEE DETAIL ON THIS SHEET.

7. ALL PAINT, SOLVENTS, PETROLEUM PRODUCTS AND PETROLEUM WASTE PRODUCTS, AND STORAGE CONTAINERS (SUCH AS DRUMS, CANS, OR CARTONS) SHALL BE STORED ACCORDING TO BMPS. THE MATERIALS EXPOSED TO PRECIPITATION SHALL BE STORED IN WATERTIGHT, STRUCTURALLY SOUND, CLOSED CONTAINERS. ALL CONTAINERS SHALL BE INSPECTED FOR LEAKS OR SPILLAGE DURING THE ONCE PER WEEK INSPECTION OF BMPS. IF SUBSTANCES SUCH AS OIL, DIESEL FUEL, HYDRAULIC FLUID, ANTIFREEZE, ETC. ARE SPILLED, LEAKED, OR RELEASED ONTO SOIL, THE SOIL SHALL BE DUG UP AND PROPERLY DISPOSED OF. SPILLS ON PAVEMENT SHALL BE ABSORBED WITH SAWDUST, KITTY LITTER OR PRODUCT DESIGNED FOR THAT PURPOSED AND DISPOSED OF AT A LICENSED SANITARY LANDFILL. HAZARDOUS OR INDUSTRIAL WASTES SUCH AS MOST SOLVENTS, GASOLINE, OIL-BASED PAINTS, AND CEMENT CURING COMPOUNDS REQUIRE SPECIAL HANDLING. THESE MATERIALS WILL BE REMOVED FROM THE SITE AND RECYCLED OR DISPOSED OF IN ACCORDANCE WITH MoDNR REQUIREMENTS.

8. STATE LAW REQUIRES THE PARTY RESPONSIBLE FOR A PETROLEUM PRODUCT SPILL IN EXCESS OF 50 GALLONS TO REPORT THE SPILL TO MoDNR (573-634-2436) AS SOON AS PRACTICAL AFTER DISCOVERY. FEDERAL LAW REQUIRES THE RESPONSIBLE PARTY TO REPORT ANY RELEASE OF OIL IF IT REACHES OR THREATENS A SEWER, LAKE, CREEK, STREAM, RIVER, GROUNDWATER, WETLAND, OR AREA, LIKE A ROAD DITCH, THAT DRAINS INTO ONE OF THE ABOVE.

9. SUFFICIENT TEMPORARY TOILET FACILITIES TO SERVE THE NUMBER OF WORKERS ON THE SITE SHALL BE PROVIDED. THE FACILITIES SHALL BE SERVICED FREQUENTLY TO MAINTAIN SANITARY CONDITIONS.

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| Branson MISSOURI Engineering & Public Works | POLLUTION PREVENTION PROCEDURE NOTES | STANDARD DRAWING 1-7 | |
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TOPSOIL REQUIREMENTS:

PERMANENT AND TEMPORARY SEEDING –
LOOSEN COMPACTED SOILS TO A DEPTH OF 4 INCHES. IF RAINFALL CAUSES THE SURFACE TO BECOME SEALED OR CRUSTED, LOOSEN IT JUST PRIOR TO SEEDING. SLOPES STEEPER THAN 33 PERCENT (3:1) GRADE SHOULD BE GROOVED OR FURROWED ON THE CONTOUR BEFORE SEEDING. A GOOD SEEDBED IS WELL PULVERIZED, LOOSE, AND UNIFORM.

PERMANENT SEEDING –
A MINIMUM OF 4 INCHES OF LOOSE TOPSOIL SHOULD BE SPREAD ON AREAS TO BE SEEDED.

LIME REQUIREMENTS:

PERMANENT AND TEMPORARY SEEDING –
LIME SHOULD BE APPLIED ACCORDING TO SOIL TEST RECOMMENDATIONS. IF THE PH OF THE SOIL IS UNKNOWN, LIME SHALL BE INCORPORATED INTO THE TOP 4 INCHES OF SOIL AT THE RATE OF 1500 POUNDS EFFECTIVE NEUTRALIZING

FERTILIZER REQUIREMENTS:

PERMANENT SEEDING –
FERTILIZER SHOULD BE APPLIED BASED ON SOIL TESTS. WHEN THESE ARE NOT POSSIBLE, A 13–13–13 GRADE FERTILIZER SHALL BE INCORPORATED INTO THE TOP 4 INCHES OF SOIL AT THE RATE OF 500 POUNDS PER ACRE.

TEMPORARY SEEDING –
FERTILIZER SHOULD BE APPLIED BASED ON SOIL TESTS. WHEN THESE ARE NOT POSSIBLE, A 10–10–10 GRADE FERTILIZER SHALL BE INCORPORATED INTO THE TOP 4 INCHES OF SOIL AT THE RATE OF 200 POUNDS PER ACRE.

SEED REQUIREMENTS:

PERMANENT SEEDING –
SEED MIX SHALL CONSIST OF NINETY PERCENT (90%) TALL FESCUE AND TEN PERCENT (10%) ANNUAL RYEGRASS. SEED MIXTURE SHALL BE APPLIED AT A RATE OF 400 POUNDS PER ACRE.

TEMPORARY SEEDING – SEED MIX SHALL CONSIST OF ANY COMBINATION OF TALL FESCUE, ANNUAL RYEGRASS, SUDAN, MILLET, WHEAT, OR OATS. SEED MIXTURE SHALL BE APPLIED AT A RATE OF 200 POUNDS PER ACRE.

DORMANT SEASON SEEDING – SEED MIX SHALL CONSIST OF 80 PERCENT (80%) TALL FESCUE, TEN PERCENT (10%) POUNDS PER ACRE.

MULCH REQUIREMENTS:

PERMANENT AND TEMPORARY SEEDING –
WHERE SLOPES ARE LESS THAN 25 PERCENT (4:1) GRADE, CEREAL GRAIN MULCH IS REQUIRED AT THE RATE OF 100 POUNDS PER 1,000 SQUARE FEET (4,500 LBS/ACRE). CEREAL GRAIN MULCH SHALL MEET THE REQUIREMENTS OF

SLOPES ARE 25 PERCENT (4:1) OR GREATER GRADE, TYPE 3 MULCH ("HYDROMULCH") MEETING THE REQUIREMENTS OF SECTION 802 OF THE STATE SPECIFICATIONS SHALL BE USED. TYPE 3 MULCH SHALL BE APPLIED AT A MINIMUM RATE OF 2,000 LBS/ACRE.

DATES FOR SEEDING:

PERMANENT SEEDING – MARCH 1 TO JUNE 1 AND AUGUST 15 TO NOVEMBER 1
TEMPORARY SEEDING – CAN OCCUR DURING ANY SEASON, HOWEVER WINTER IS THE LEAST TOLERANT.
DORMANT SEASON SEEDING – DECEMBER 15 TO FEBRUARY 29

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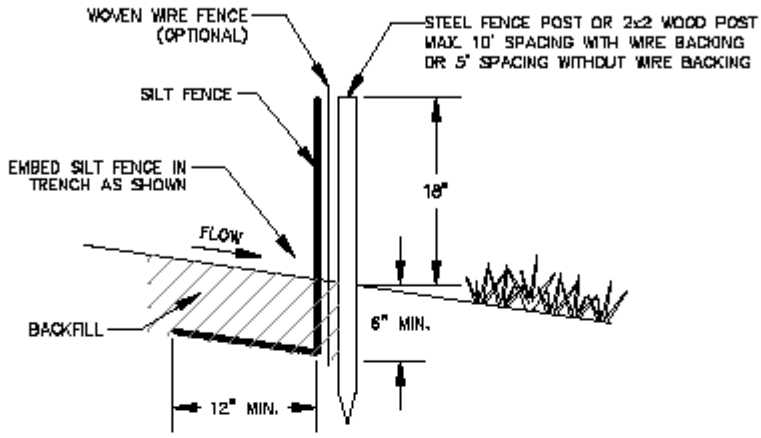
| Branson MISSOURI Engineering & Public Works | TEMPORARY & PERMANENT VEGETATION REQUIREMENTS | STANDARD DRAWING 1-8 | |
| | | ADOPTED 2023 | REVISION |




## NOTES:

1. PLACE SILT FENCE AT DOWNSLOPE LIMIT OF AREA TO BE GRADED.
2. SILT FENCE SHALL BE PLACED ALONG A LEVEL CONTOUR WITH AN ALLOWANCE OF ± 4 INCHES.
3. SEDIMENT TRAPPED BY THIS PRACTICE SHALL BE DISPOSED OF IN AN APPROVED SITE IN A MANNER THAT WILL NOT CONTRIBUTE TO ADDITIONAL SILTATION.
4. SILT FENCE SHOULD BE SECURELY FASTENED TO EACH SUPPORT POST OR TO WOVEN WIRE, WHICH IS IN TURN ATTACHED TO THE STEEL FENCE POSTS.
5. INSPECTION SHALL BE FREQUENT AND REPAIR OR REPLACEMENT SHALL BE MADE PROMPTLY AS NEEDED.
6. SILT FENCE SHALL BE REMOVED WHEN IT HAS SERVED ITS USEFULNESS SO AS NOT TO BLOCK OR IMPEDE STORM FLOW OR DRAINAGE.
7. ACCUMULATED SILT SHALL BE REMOVED WHEN IT REACHES A DEPTH OF ½ THE HEIGHT OF THE FENCE.
8. AT EACH END OF SILT FENCE, TURN FENCE UPSLOPE AND EXTEND UNTIL GROUND SURFACE RISES 18 INCHES.

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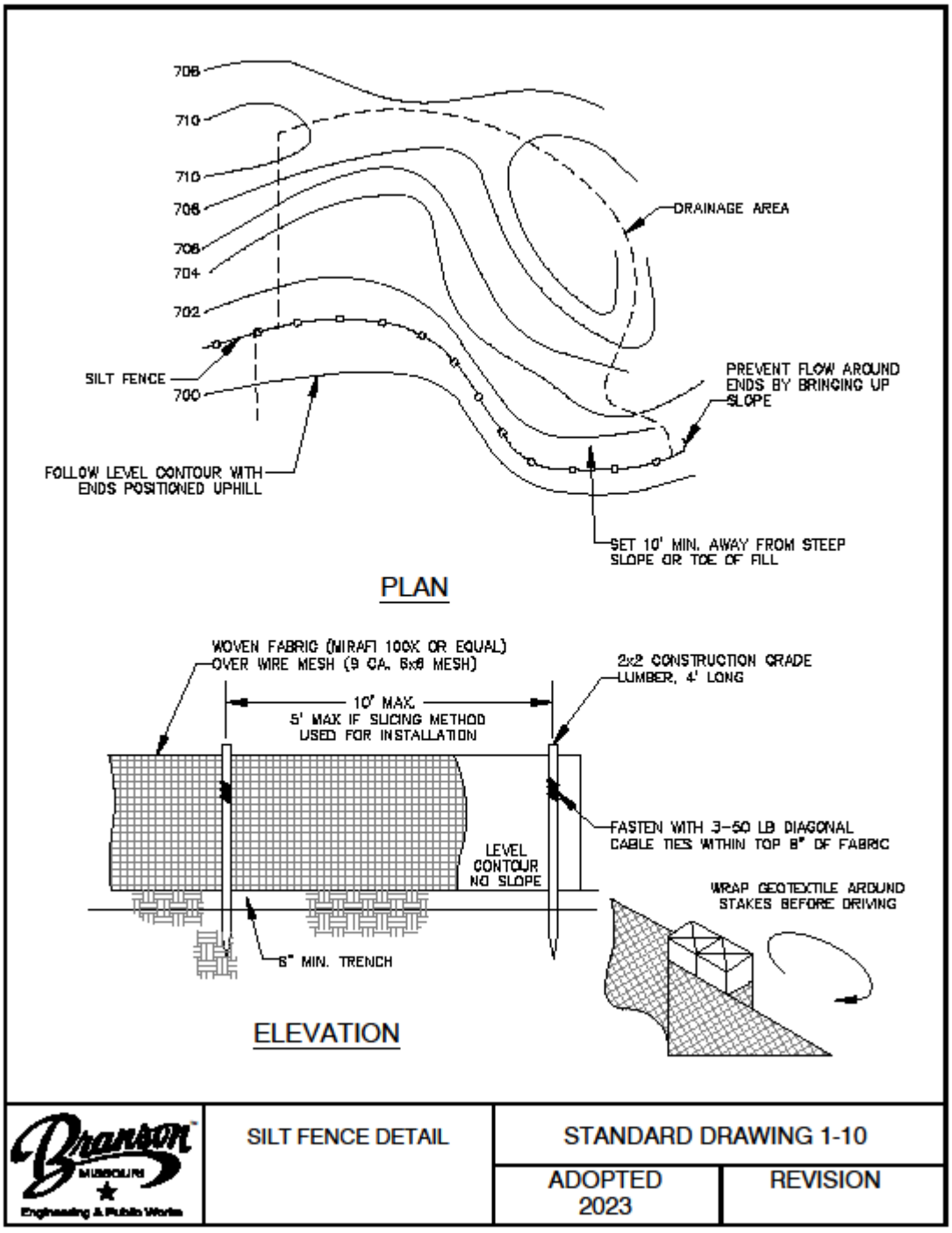
| Branson MISSOURI Engineering & Public Works | SILT FENCE DETAIL | STANDARD DRAWING 1-9 | |
| | | ADOPTED 2023 | REVISION |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SILT FENCE
DRAINAGE AREA
PREVENT FLOW AROUND ENDS BY BRINGING UP SLOPE
FOLLOW LEVEL CONTOUR WITH ENDS POSITIONED UPHILL
SET 10' MIN. AWAY FROM STEEP SLOPE OR TOE OF FILL
PLAN
WOVEN FABRIC (MIRAFI 100X OR EQUAL) OVER WIRE MESH (9 GA. 6x6 MESH)
10' MAX.
5' MAX IF SLICING METHOD USED FOR INSTALLATION
2x2 CONSTRUCTION GRADE LUMBER, 4' LONG
FASTEN WITH 3-50 LB DIAGONAL CABLE TIES WITHIN TOP 8" OF FABRIC
LEVEL CONTOUR NO SLOPE
WRAP GEOTEXTILE AROUND STAKES BEFORE DRIVING
6" MIN. TRENCH
ELEVATION
Branson MISSOURI
Engineering & Public Works
SILT FENCE DETAIL
STANDARD DRAWING 1-10
ADOPTED 2023
REVISION

SECTION 5000 MATERIALS, CONSTRUCTION AND TESTING - WATER LINES

5001 GENERAL. The purpose of this specification is to govern the furnishing of all materials, labor, equipment, tools, superintendence, and other services necessary to construct water mains, complete with appurtenances including extensions and relocations at the locations shown on the plans. All water system materials and installation shall conform to current AWWA standards.

5002 MATERIALS.

A. Scope. This section governs materials for water mains having diameter of two inches (2") and larger.

B. Pipe and Fittings.

1. Ductile-Iron

a. Pipe. Unless indicated otherwise on the construction plans or directed by the Engineer, all six inch (6") pipe and larger shall be Class 50 ductile iron, all four inch (4") pipe shall be Class 51 Ductile iron complete with all accessories and conforming to ANSI A21.51, AWWA C151, ASTM A536, and Grade 60-42-10 (two inch (2") pipe shall be PVC).

Joints, unless otherwise specified, shall be of the push-on type conforming to ANSI A21.11/AWWA C111, except gaskets shall be synthetic rubber. Natural rubber is not acceptable. The pipe shall be cement mortar lined, conforming to ANSI A21.4/AWWA C104 and shall be coated inside and out with a bituminous coating.

b. Fittings. Ductile-iron fittings shall be complete with all accessories and shall be ASTM A536, Grade 70-50-05, conforming to ANSI A21.53/AWWA C153, 350 psi pressure rating. Joints shall be of the standard mechanical joint type conforming to ANSI A21.11/AWWA C104 and shall be coated inside and out with a bituminous coating. Fittings shall have distinctly cast upon them the pressure rating and letters "DI" or "DUCTILE".

2. PVC (Polyvinyl chloride) Pipe. PVC pressure pipe shall be designed to carry potable water at pressures (including surge) up to the maximum class rating. Materials from which the pipe, couplings, and fittings are manufactured shall conform to ASTM D1784, Type 1, Grade 1, 2,000 psi design stress. The minimum wall thickness for the pipe shall be SDR 21 (Class 200).

All PVC pipe shall conform to the latest revisions of ASTM D2241 pressure rated pipe, and National Sanitation Foundation Testing Laboratories (NSF). Pipe end gaskets, meeting the requirements of ASTM F477, shall be synthetic rubber. Natural rubber is not acceptable. Gaskets shall be held in place with glue or other adhesive sufficient to hold gasket in place during the insertion of

the adjoining pipe.

The couplings and fittings shall accommodate the pipe for which they are used. The minimum pressure ratings shall be 235 psi for couplings and 250 psi for the fittings. The insertion depth of the pipe in the coupling shall be controlled by an internal PVC mechanical stop in the coupling. Each pipe and fitting shall be plainly and permanently marked thereon:

a. Manufacturer's name and trademark
b. Nominal pipe size
c. ASTM Designation D 2241
d. SDR Number
e. Material designation

C Valves and valve Boxes.

1. Gate Valves. Generally, and unless otherwise directed by the Engineer, gate valves shall be used on all water mains, up to and including, 12-inch nominal diameter. The type, size and location of valves shall be as shown on the plans. Except as modified or provided herein all gate valves in pipe lines shall be 200 psi, iron body, gate valves with non-rising stems. Gate valves shall be resilient-seated conforming to all applicable requirements of ANSI/AWWA C509 and/or C515. All gate valves shall have a stainless steel stem. Gate valves shall be Clow 2639 or 2640, Mueller A-2360, or AVK Series 65, or approved equal.

2. Butterfly Valves. Butterfly valves shall be used for water lines larger than 12 inches in diameter unless otherwise directed by the director of public works/engineering. Butterfly valves shall be of the rubber-seat, tight-closing type. Valve discs shall seat at 90 degrees with the pipe axis. Flanged end valves shall be of the short body type. For buried service, shaft shall be O-ring type. All butterfly valves shall have a stainless steel shaft.

   All butterfly valves and operators shall conform to AWWA C504. Metal mating seat surfaces shall be 18-8 stainless steel or monel. Each valve shall be provided with an operator with a torque rating at least equal to the torques listed in AWWA C504, Table 1.

   Butterfly valve shall be GA Industries (Class 150B and 250B), Series 800, or approved equal.

3. Valve Ends. Valve ends shall be of the mechanical joint type, conforming to ANSI A21.11/AWWA C111 except where flange ends are required on the plans.

   The end flanges of flange gate valves shall conform in dimensions and drilling to ANSI B16.1 for cast-iron flanges and flange fittings, Class 125, unless explicitly provided otherwise on the plans and Special Provisions. The laying lengths of the

flange valves shall conform to the dimensions of ANSI B16.10.

All valves within proximity of tees and fittings shall be restrained with stainless steel all-thread or anchor couplings to the tee and/or fitting.

4. Bonnet Thrust Plates. The bonnet shall have a removable thrust plate to permit the removal and replacement of the valve stem and "O" ring seal while the valve is in service.
5. Tapping Valves and Sleeves.

Connections three inch (3") or larger:

The valves shall be 200 psi, resilient-seated, cast iron body, non-rising stem gate valves conforming to all applicable requirements of AWWA C509 and shall be Mueller "No. A-2361" or an approved equal. Each tapping valve shall be provided with a flanged inlet end designed, faced and drilled for connection to the outlet end of the tapping sleeve. The outlet end of the tapping valve shall be provided with a tapping flange for attachment of a standard drilling machine and also with a mechanical joint-type bell end for connection of the branch main.

Tapping sleeves shall be of the flanged-outlet type designed for attachment to the flanged inlet end of the tapping valve, and shall be provided with mechanical joint ends at each end of the run and shall be a JCM 422 ESS, Ford FTSC SC or approved equal. All hardware must be stainless steel.

Connections two inch (2") or smaller:

Three-quarter inch (3/4") and one inch (1") valves shall be key corporation stops and shall be a Ford "F1000" series or approved equal. Two inch (2") valves shall be brass ball valve curb stops and shall be Ford "B81-777-QT67" or approved equal for horizontal taps. Vertical taps shall be Ford "B81-777-NL" or approved equal.

PVC "Class 200":

Tapping saddles for three-quarter inch (3/4") or one inch (1") services shall be brass and Ford "S70" AWWA thread style or approved equal. Tapping saddles for two inch (2") services shall be brass and Ford "S71" FIP thread style or approved equal.

PVC "C900":

Tapping saddles for three-quarter inch (3/4") or one inch (1") services shall be brass and Ford "S90" AWWA thread style or approved equal. Tapping saddles for two inch (2") services shall be brass and Ford "S91" FIP thread style or approved equal.

Ductile Iron:

Tapping saddles for three-quarter inch (3/4") or one inch (1") services shall be brass and Ford "FC" AWWA thread style with stainless steel band, bolts and nuts or approved equal. Tapping saddles for two inch (2") services shall be brass and Ford "FC" FIP thread style with stainless steel band, bolts and nuts or approved equal.

6. Stem Seals and Coatings.

   a. All valves shall be provided with stem seals of the "O" ring type. Two (2) "O" rings shall be used with at least one (1) "O" ring inserted above the thrust collar. The packing plate shall be attached to the valve bonnet by not less than three (3) bolts and one (1) "O" ring below the thrust collar.

   b. All exterior surfaces of each valve shall be cleaned and painted in the shop with two (2) coats of asphalt varnish conforming to Federal Specifications TT-V-51-E or be epoxy coated. The interior surfaces of resilient-seated gate valves shall have a protective coating of fusion-bonded, nontoxic epoxy which is safe for potable water.

7. Valve Operation. All valves shall be equipped with a two inch (2") square wrench nut and the direction of rotation to open the valve shall be to the left (counterclockwise). Each valve body or operator shall have cast thereon the word "Open" and an arrow indicating the direction to open.

8. Extension Stems. Extension stems and stem guides shall be provided where shown, specified, or required for proper operation. Extension stems shall be fabricated from solid steel shafting not smaller in diameter than the stem of the valve or from galvanized steel piping having an I.D. not smaller than the O.D. of the valve stem. Extension stems shall be connected to the valve by a flexible, socket-type coupling. All connections shall be pinned, keyed, or socket type. Pipe couplings will not be acceptable.

   Extension stems shall be provided for buried valves when the operating nut is more than three feet below finished grade. Each extension stem for a buried valve shall extend to within three feet (3') of the ground surface, shall be provided with spacers which will center the stem in the valve box, and shall be equipped with a wrench nut.

9. Valve boxes, Bases, Lids and Covers.

   a. All buried valves shall be provided with valve boxes. Valve boxes shall be of SCH 40 or SDR 21 PVC, six inch (6") in diameter, suitable for the depth of cover required by the drawings.

   b. All parts of valve covers shall be coated by dipping in bitumastic asphaltic tar. Valve covers shall be cast iron, meeting ASTM A48 Class 30B standards and be a drop-in mushroom cap when located in a greenspace area.

When located within a pedestrian or vehicular use area, valve covers shall be flush with grade. See Standard Detail Drawings for the Clay & Bailey #2194 valve cover.

Valves and valve boxes shall be set plumb. Each valve box shall be placed directly over the valve it serves, with the top of the box brought flush with the finished grade. After being placed in proper position, earth shall be filled in around each valve box and thoroughly tamped on each side of the box. See Standard Detail Drawing.

c. Valves shall have tracer wire into valve box with a minimum of six inches (6") of wire above the valve operating nut and not between the treads on the road boxes. The installation of the tracer wire shall follow the requirements of this section.

10. Hardware. All bolts, washers, and nuts must be stainless steel.

D. Fire Hydrants.

Fire hydrants shall be Mueller A-423 Super Centurion 250 or Clow Model #2545 Medallion and shall be furnished with a six inch (6") auxiliary gate valve. All hydrants shall have one 4 ½ inch pumper nozzle and two 2 ½ inch nozzles. The fire hydrants shall be pressure rated at 150 psi working pressure and 300 psi test pressure. Hydrants shall be traffic model with breakaway flange or coupling. All hydrants shall have either a mechanical joint or flanged shoe and shall be furnished with auxiliary gate valves. Fire hydrants shall conform to AWWA C502 with information required by Section 2 as follows:

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|---|---|
| Type of Shutoff | Compression |
| Size of Hydrant | 5 1/4 inches |
| Inlet Connection | 6 inches |
| Outlet Nozzles | 2-2 1/2-inch hose and 1-4 1/2-inch pumper |
| Outlet Nozzle Threads | ANSI B-26 |
| Direction to Open | Counterclockwise |
| Stem Seals | O-ring |
| Outlet Nozzle Cap Chains | Required |

| | |
|---|---|
| Drain Outlet | Required |
| Finish Paint | Factory painted above the ground line with red reflective enameled paint |

Hydrants shall be furnished with all joint glands, gaskets, bolts, and nuts required for installation. Hydrants shall be set so that at least the minimum pipe cover is provided for the branch supply line. Each hydrant shall be set on an eight inch (8") by sixteen inch (16") by four inch (4") concrete cap block foundation.

Hydrant drainage shall be provided by installing at least one-half (1/2) cubic yard of ¾" to one inch (1") clean crushed stone aggregate around the hydrant, and below the top of the hydrant supply pipe.

Fire hydrant installations shall conform to the Standard Detail Drawing. All hydrants shall stand plumb. The exact direction the nozzles will be facing shall be determined by the fire code official.

E. Specials.

1. General. Air release, meter, and pressure-reducing valve vaults shall be precast concrete conforming to ASTM C478. Access lid castings shall be as noted in the Special Provisions or as shown on the plans.

   Vaults which, by their special nature, must be cast in place shall conform to the plans and concrete specifications in Section 2000 "Concrete".

2. Pressure-Reducing Valves. Pressure-reducing valves shall be as noted in the special provisions, selected and sized as recommended by the valve manufacturer. Pressure-reducing valves shall be suitable for operation under the pressure and flow conditions as shown on the plans.

3. Combination Air Valves. Combination air-release and vacuum-relief valves shall be installed at the locations indicated on the plans. Each valve assembly shall be installed complete with appropriate piping and valves as shown on the plans. All piping and isolation valves shall be brass except for the air outlet from the valve which shall be brass or copper tubing.

   Air releases for mains 12 inches in diameter or smaller, shall have one inch (1") combination air-release valves, APCO No. 143C or approved equal.

   The open end of the air relief pipe from automatic valves shall be extended to at least one foot (1') above grade and terminate in a downturn position with the opening covered with an 18-mesh, corrosion resistant screen.

The discharge pipe from a manually operated valve shall be capped with a threaded removable cap or plug and be extended to the top of the pit.

Vaults or wells housing automatic air relief valves shall be drained to daylight with drains sized to carry the maximum output of the air relief valve.
conforming in dimensions and drilling to ANSI B16.1, Class 125.

4. Brass Fittings. All brass fittings shall be NSF 61 compliant.

F. Tracer Wire. Tracer wire shall be installed on all water mains, service lines and appurtenances. The tracer wire and its appurtenances shall be color coded per American Public Works Association (APWA) standard for the specific utility being marked.

1. Tracer Wire:

a. Open Trench. Tracer wire shall be a (14, 12 or 10 AWG SOLID HDPE 30 MIL) copper conductor with a 30 mil thick, high-density, high molecular weight polyethylene (HDPE) insulation and rated for 30 volts. Insulation and jacket shall be RoHS compliant and utilize virgin grade material. Insulation color shall meet the APWA color code standard for identification of buried utilities. Tracer wire shall be Pro-Line Safety Products or approved equal and made in the USA.

b. Directional Drilling/Boring. Tracer wire shall be #12 AWG Copper Clad Steel, totally annealed 1055 steel. Extra high strength, minimum breaking load of 1,150 lbs., with a minimum HDPE coating of 45 mils.

c. Pipe Bursting. Tracer wire shall be #.2403" AWG Copper Clad Steel, totally annealed 1055 steel. Extreme strength, stranded, minimum breaking load of 4,700 lbs., with a minimum HDPE coating of 50 mils.

i. Location Tape. Marking tape shall be installed 12 inches above the pipe in paved areas and shall be blue in color and have "Buried Water Line Below" printed on the tape at 20 to 30 inch intervals. The tape shall be installed directly above the centerline of the pipe.

ii. Connectors:

a) Direct bury wire connectors, including 3-way direct bury lug connector: "Copperhead SnakeBite Locking Connectors" or approved equal. Mainline splice to service line connection shall be specifically manufactured for use in underground trace wire installation, shall be dielectric silicon filled to seal out moisture and corrosion, and shall be installed in a manner so as to prevent any uninsulated wire exposure.

b) All mainline trace wires must be interconnected in

intersections, at tees and crosses. At tees, the three wires shall be joined using a single 3-way direct bury lug connector. At crosses, the four wires shall be joined using a 4-way connector. Using two 3-way connectors with a short jumper wire between them is an acceptable alternative.

c) Directional drilling and pipe bursting splicing is not allowed on the main line. Intersection splicing will follow guidance for direct bury connectors.

iii. Termination / Access: All tracer wire termination points must utilize an approved tracer wire access box. A minimum of two feet (2') of excess wire is required in all grade level tracer wire access boxes after setting at final grade.

a) Service lines: Access to the tracer wire shall be through the water meter box/vault, located at the right-of-way line or permanent easement line. The tracer wire shall connect to the main line trace wire using an approved mainline to lateral lug connector. See Standard Detail Drawing.

b) Water Main: Access to the tracer wire shall be through a valve box or an approved access box at both ends of the water main. The tracer wire shall terminate at both ends with an approved grounding anode. See Standard Detail Drawing.

c) On long-runs, in excess of 500 linear feet without service lines, tracer wire access must be provided utilizing an approved in-ground tracer wire access box. The box must be located out of the roadway and delineated using a polyethylene marker post, color coded per American Public Works Association (APWA) standard for the specific utility being marked.

iv. Grounding:

a) Tracer wire must be properly grounded at all dead ends/stubs.

b) Grounding of tracer wire shall be achieved by use of a drive-in magnesium grounding anode rod with a minimum of 20 linear feet of #14 AWG HDPE copper clad wire connected to the anode.

v. Installation General:

a) Tracer wire installation shall be performed in such a manner that allows proper access for connection of line tracing equipment, proper locating of wire without loss or deterioration of low frequency (512 Hz) signal for distances in excess of 1,000 linear feet, and without distortion of signal caused by multiple wires being installed in close proximity to one another.

b) Tracer wire system must be installed as a continuous single wire. No looping or coiling of wire is allowed.

c) Any damage occurring during installation of the tracer wire must be immediately repaired in an approved waterproof method. Taping and/or spray coating shall not be allowed.

d) All mainline dead-ends shall go to ground using an approved waterproof connection to a drive-in magnesium grounding anode rod, buried at the same depth as the trace wire. The anode will be buried on the opposite side of the utility at the furthest most point. The anode wire will be connected in the trace wire access box to the trace wire utilizing the connection point in the access box.

e) Mainline tracer wire shall not be connected to existing conductive pipes. Treat as a mainline dead-end, ground using an approved waterproof connection to a grounding anode, buried at the same depth as the trace wire.

f) All service line tracer wires shall be connected to the mainline with a single wire using a mainline to lateral lug connector, installed without cutting/splicing the mainline tracer wire. Looping will not be allowed.

g) In occurrences where existing trace wire is encountered on an existing utility that is being extended or tied into, the new and existing trace wire shall be connected using approved splice connectors, shall be properly grounded at the splice location as specified and be completely waterproof to prohibit corrosion and loss of conductivity.

vi. Prohibited Products and Methods: The following products and methods shall not be allowed or acceptable.

a) Uninsulated tracer wire
b) Tracer wire insulations other than HDPE
c) Twist-on wire connectors
d) Brass or copper ground rods

e) Wire connections utilizing taping or spray-on waterproofing
f) Looped wire or continuous wire installations, that has multiple wires laid side-by-side or in close proximity to one another
g) Brass fittings with trace wire connection lugs
h) Wire terminations within the roadway
i) Connecting tracer wire to existing conductive utilities

vii. Testing: All new tracer wire installations shall be located using typical low frequency (512 Hz) line tracing equipment, witnessed by the city personnel, prior to acceptance of ownership. This verification shall be performed upon completion of rough grading and prior to final acceptance of the project. Continuity testing in lieu of actual line tracing shall not be accepted.

G. Bedding Aggregate. All materials used for pipe bedding shall be ¾" to one inch (1") clean crushed stone aggregate

## 5003 CONSTRUCTION REQUIREMENTS.

### A. Grading and Excavation.

1. Scope. Excavation and trenching work shall include the necessary clearing, grubbing, and preparation of the site; removal and disposal of all debris; excavation and trenching as required; the handling, storage, transportation and disposal of all excavated material; all necessary sheeting, shoring and protection work; preparation of subgrades; pumping and dewatering as necessary or required; protection of adjacent property; and other appurtenant work.

2. General. Excavation and trenching work shall be performed in a safe and proper manner with suitable precautions being taken against all hazards.

   The Contractor shall explore and expose any and all obstructions in advance of excavation so that minor changes in grade and alignment may be made.

   In paralleling existing water, sewer, and gas mains, the Contractor shall protect all service connections and shall arrange to furnish service to the consumers with minimum interruption.

   All excavated material shall be piled in a manner that will not endanger the work and that will avoid obstructing sidewalks and driveways. Gutters shall be kept clear or other satisfactory provisions made for street drainage.

3. Classification of Excavated Material. No classification of excavated materials will be made unless otherwise indicated on the contract drawings. Excavation and trenching work shall include the removal and subsequent handling of all materials

excavated or otherwise removed in performance of the contract work regardless of the type, character, composition, or condition thereof.

4. Unauthorized Excavation. Any part of the trench excavated below grade shall be corrected with material approved by the Engineer placed and compacted by the Contractor.

5. Removal of Water. The Contractor shall provide and maintain adequate dewatering equipment to remove and dispose of all surface and groundwater entering excavations, trenches, or other parts of the work. Each excavation shall be kept dry during sub-grade preparation and continually thereafter until the structure to be built or the pipe to be installed therein, is completed to the extent that no damage from hydrostatic pressure, flotation or other cause will result.

   All excavations for concrete structures or trenches which extend down to or below static groundwater elevations shall be dewatered by lowering and maintaining the groundwater surface beneath such excavations a distance of not less than 12 inches below the bottom of the excavation.

   Surface water shall be diverted or otherwise prevented from entering excavated areas or trenches to the greatest extent practicable without causing damage to adjacent property.

   The Contractor will be held responsible for the condition of any pipe or conduit which he may use for drainage purposes, and all such pipes or conduits shall be left clean and free of sediment.

6. Sheeting and Shoring. Except where banks are cut back on a stable slope, excavation for structures and trenches shall be properly and substantially sheeted, braced, or shored as necessary to prevent caving or sliding, to provide protection for workmen and the work, and to provide protection for existing structures and facilities. Sheeting, bracing and shoring shall be designed and built to withstand all loads that might be caused by earth movement or pressure and shall be rigid, maintaining shape and position under all circumstances.

   Trench sheeting shall not be pulled unless pipe strength is sufficient to carry trench loads based on trench width to the back of sheeting. Sheeting shall not be pulled after backfilling. When ordered by the Engineer, wood sheeting shall be left permanently in the trench.

   Where trench sheeting is left in place, such sheeting shall not be braced against the pipe, but shall be supported in a manner which will preclude concentrated loads or horizontal thrusts on the pipe. Cross braces installed above the pipe to support sheeting may be removed after pipe embedment has been completed.

7. Stabilization. Trench bottoms shall be firm, dense, and thoroughly compacted

and consolidated; shall be free from mud and muck; and shall be sufficiently stable to remain firm and intact under the feet of the workmen.

Trench bottoms which are otherwise solid but which become mucky on top due to construction operations shall be reinforced with one or more layers of crushed stone or gravel. Not more than 1/2-inch depth of mud or muck shall be allowed to remain on stabilized trench bottoms when the pipe bedding material is placed thereon.

8. Trench Excavation. The Contractor shall not open more trench in advance of pipe laying than is necessary to expedite the work. One block or 300 feet whichever is the shorter, shall be the maximum length of open trench ahead of pipe laying unless by written permission of the Engineer.

Except where tunneling or boring and jacking is specified and shown on the plan by the Engineer, all trench excavations shall be open cut.

9. Alignment and Grade. The alignment and grade or elevation of the pipeline shall be as shown on the plans.

The Contractor must maintain a constant check of the pipe alignment and trench depth and will be held responsible for any deviations therefrom.

Unless otherwise shown or indicated on the plans or unless otherwise set forth by the Engineer, the horizontal and vertical alignment of the water main shall be maintained to within the following tolerances:

| Horizontal | Vertical |
|---|---|
| 3" | 42" to 60" Depth of Cover |

10. Depth of Cover. Except where otherwise shown, trenches shall be excavated to a depth sufficient to provide a minimum depth of backfill cover over the top of the pipe as indicated above. Greater pipe cover depths may be necessary on existing pipe, conduits, drains, drainage structures, or other obstruction encountered at normal pipe grades.

Measurement of pipe cover depth shall be made vertically from the outside top of pipe to finish grade or pavement surface elevations. The minimum shall be 42 inches with a maximum cover not to exceed 60 inches.

11. Limiting Trench Width. Trenches shall be excavated to a width which will provide adequate working space and pipe clearances for proper pipe installation, jointing and embedment. However, the limiting trench width below an elevation six inches (6") above the top of the installed pipe and seven and a half inches (7 ½") 

to 12 inches of clearance on each side of the pipe, See Standard Detail Drawing.

Where necessary to reduce earth load on trench banks to prevent sliding and caving, banks may be cut back on slopes which shall not extend lower than 1 foot above the top of the pipe.

12. Unauthorized Trench Widths. When the excavated width of the lower portion of the trench exceeds the maximum permitted, at any point, the following shall be furnished and installed by and at the contractor's expense: a pipe of adequate strength, special pipe embedment, or arch concrete encasement, as required by loading conditions and as determined by the Engineer.

13. Trench Bottom in Earth. All earth excavation shall be carried to a minimum of six inches (6") below the bottom of the pipe. Embedment aggregate shall be used to restore the trench bottom to the desired elevation and grade and to provide a uniform bearing and continuous support for the pipe along its entire length.

14. Rock Exploration. Unless shown otherwise on the plans or noted in the Special Provisions, no rock exploration has been made. On those projects where rock exploration has been made, test holes have been drilled at locations and intervals as shown on the plans or subsurface information report to determine the approximate location and depth of rock. Resistance to penetration was assumed to be "solid rock". This information is furnished for general reference purposes only.

15. The Contractor must form his own opinion as to the character of materials which will be encountered from an inspection in the ground, from his own investigation of the test hole information, or from such other investigations as he may desire.

16. Trench Bottoms in Rock. All rock excavation shall be carried to a minimum of 12 inches below the bottom of the pipe. Granular pipe embedment material shall be used to restore the trench bottom to the desired elevation and grade and to provide a uniform bearing and continuous support for the pipe along its entire length. Care shall be exercised to prevent any portion of the pipe from coming to bear on solid rock or boulders.

17. Mechanical Excavation. The use of mechanical equipment will not be permitted in locations where its operations would cause damage to trees, buildings, culverts, or other existing property, utilities or structures above or below ground, in all such locations, hand-excavating methods shall be used.

Mechanical equipment used for trench excavation shall be of the type, design and construction and shall be so operated that the rough trench excavation bottom elevation can be controlled, that uniform trench widths and vertical sidewalls are obtained at least from the bottom of the trench, and that trench alignment will be centered in the trench with adequate clearance between the pipe and sidewalls of the trench. Undercutting the trench sidewall to obtain clearance will not be

permitted.

All mechanical trenching equipment, its operating conditions, and the manner of its operations shall be subject at all times to the approval of the Engineer.

B. Crossings.

1. Water Crossings. Water crossings shall be made in accordance with these specifications and as shown on the plans.

a. Flowing Streams.

1. The pipe must be encased in a welded steel casing.

2. Valves shall be provided at both ends of water crossings so that the section can be isolated for testing or repair; the valves shall be easily accessible and should not be subject to flooding; and the valve closest to the supply source shall be in an accessible location. The total length of the casing shall be the minimum distance the valves shall be from the casing.

3. The casing shall extend at least 15 feet beyond the upper edge of the stream channel on each side of the stream.

b. Intermittent Flowing Streams.

1. The pipe trench shall be concrete capped or the pipe shall be encased in a welded steel casing.

2. The pipe shall extend at least 15 feet beyond the upper edge of the stream channel on each side of the stream.

2. Highway and Railroad Crossings. The Contractor shall make highway and railroad crossings in accordance with these specifications, the Special Provisions and as shown on the plans.

All construction or work performed and all operations of the Contractor, his employees, or his subcontractors within the limits of highway or railroad right-of-ways shall be in conformity with all the requirements, regulations and be under the control (through the Engineer) of the authority owning or having jurisdiction over and control of the right-of-way.

The Contractor shall pay fees and obtain permits to make the crossings unless otherwise directed.

3. Street Crossings. Open cutting of streets shall be allowed only where permitted by

the Director of Public Works/Engineering. At locations where open cutting is not permitted, the crossing shall be made by boring or tunneling. Crossings made by boring or tunneling shall require a casing pipe unless otherwise approved by the city. All work and materials shall be in conformity with all requirements of the Technical Specifications of the City of Branson. 4. Boring or Tunneling. Crossings made by boring or tunneling shall require a casing pipe unless otherwise approved by the director of public works/engineering. The diameter and length of the casing pipe to be used shall be as determined by the director of public works/engineering. All work and materials shall be in conformity with all requirements of the Standard Detail Drawings. See Chapter 24 for approved materials.

C. Separation.

1. Vertical. Minimum 18 inches from any non-potable line. If unable to meet minimum, pipe shall be encased in an approved casing or with mechanical joint pipe.
2. Horizontal. Minimum 10 feet from any non-potable line or sanitary sewer manhole. If unable to meet minimum, pipe shall be encased in an approved casing or with a mechanical joint pipe.
3. Disposal facilities. Minimum of 25 feet from any wastewater disposal facility, agricultural waste disposal facility, landfill, septic tanks, cesspools, subsurface disposal fields, pit privies, land application fields, and seepage beds.
4. Dry Utilities. Minimum 7.5 feet horizontal and 18 inch vertical or as approved by.

## 5004 INSTALLATION.

A. General. Laying of pipe, embedment, backfill and the installation of valves and hydrants shall conform to the following specifications and the details as shown on the plans.

1. Unless otherwise specified or shown on the plans, the water mains shall be laid to have a minimum cover of 42 inches and maximum cover of 60 inches, measured from the finished grade or from established street grades shown on the plans.

2. Whenever pipe laying is stopped, the open end of the line shall be sealed with a watertight plug which will prevent trench water from entering the pipe.

3. Where the pipe is to be installed inside a casing pipe or tunnel liner, creosote timber skids or approved equal shall be strapped to each pipe before it is placed in the casing pipe or tunnel liner in accordance with these specifications and as shown on the plans. The ends of each casing pipe or tunnel liner shall be closed with a dry brick wall or as shown on the plans. The closures for each casing pipe or tunnel

line shall not be constructed until all testing of the line has been completed and accepted.

4. Where pipe is laid at a slope of 20% or greater, slope anchors shall be installed.

B. PVC Polyvinyl chloride) Pipe.

1. Handling. Pipe, fitting, and other accessories shall at all times be handled with care to avoid damage. Under no circumstances shall they be dropped. Pipe fittings shall be handled as specified for ductile-iron pipe. Any damaged pipe shall be rejected.

2. Cutting Pipe. All pipe shall be cut with a saw or special cutting tool. Cutting shall be done in a neat manner without damage to the pipe. Cuts shall be smooth, straight and at right angles to the pipe axis. After cutting, the end of the pipe shall be dressed and beveled. Field-cut pipe shall be bevel filed to remove any sharp or rough edges which might otherwise damage the gasket. When cutting pipe with couplings, mark the field cut pipe end the same distance in as the mark appeared on the original full-length section.

3. Cleaning. The interior of all pipe and fittings shall be thoroughly cleaned of foreign matter before being installed and shall be kept clean until the work has been accepted.

4. Pipe Laying. PVC pipe shall be installed in strict accordance with the requirements and instructions of the pipe manufacturer. It shall be protected from lateral displacement and deflection by pipe embedment material installed as specified for pipe embedment and as shown on the Standard Detail Drawings. No pipe shall be laid under unsuitable trench conditions. Whenever pipe laying is stopped, the open end of the line shall be sealed with a watertight plug which will prevent trench water from entering the pipe.

C Ductile-Iron Pipe.

1. Handling. Pipe, fittings and accessories shall be handled in a manner that will ensure installation in a sound, undamaged condition. Equipment, tools, and methods used in unloading, reloading, hauling, and laying pipe and fittings shall be such that the pipe, pipe coating, and fittings are not damaged. Hooks shall not be used. Under no circumstances shall pipe or accessories be dropped or dumped. Pipe and fittings on which the cement lining has been broken or loosened shall be replaced by the Contractor. Where the damaged areas are small and readily accessible, the Contractor may be permitted to repair the lining.

All pipe coating which has been damaged shall be repaired by the Contractor before installing the pipe.

2. Cutting Pipe. Ductile-iron pipe shall be cut with either a saw or an abrasive wheel. Cutting of existing cast-iron pipe shall be done with mechanical pipe cutters. The cutting of pipe with a torch is not permitted.

   Cutting shall be done in a neat manner without damage to the pipe or the cement lining. Cuts shall be smooth, straight, and at right angles to the pipe axis. After cutting, the end of the pipe shall be dressed with a file to remove all roughness and sharp corners.

3. Cleaning. The interior of all pipe and fittings shall be thoroughly cleaned of foreign matter before being installed and shall be kept clean until the work has been accepted. Such surfaces shall be wire brushed, if necessary, wiped clean, and kept clean until jointing is completed.

4. Inspection. Pipe and fittings shall be carefully examined for cracks and other defects immediately before installation. Spigot ends shall be examined with particular care since they are vulnerable to damage from handling. All defective, damaged, or unsound pipe and fittings shall be rejected and marked as such and removed from the site of the work.

5. Alignment of Bell-and-Spigot Pipe. Pipelines or runs intended to be straight shall be laid straight. Deflections from a straight line or grade shall not exceed the quantities stipulated in Tables 4 and 5 of ANSI/AWWA C600.

6. Laying Pipe. Pipe shall be protected from lateral displacement by pipe embedment material installed as specified. Under no circumstances shall the pipe be laid in water, and no pipe shall be laid under unsuitable trench conditions.

## 5005 JOINTING.

A. Push-on Joints. The gasket seat in the bell shall be wiped clean after which the gasket should be placed. A thick film of lubricant should be applied to all of the inner surface of the gasket and on the spigot end of the pipe.

   The lubricant and the gaskets shall be as recommended and supplied by the manufacturer of the pipe being used. The lubricant shall be odorless, tasteless, nontoxic, and suitable for use in potable water and shall be NSF 61 compliant.

   Field-cut pipe shall be bevel filed to remove any sharp or rough edges which might otherwise damage the gasket.

B. Mechanical Joints. The mechanical joint shall be used only when shown on the plans and shall be installed in strict accordance with the manufacturer's recommendations. PVC pipe shall use Stargrip 4100P or approved equal.

C. Flanged Joints. When bolting flanged joints, care shall be taken to ensure that there is no

restraint on the opposite end of the pipe or fitting which would prevent uniform gasket compression or which would cause unnecessary stress in the flanges. One flange shall be free to move in any direction while the flange bolts are being tightened. Bell-and-spigot joints shall not be packed or assembled until all flanged joints affected have been tightened. Bolts shall be tightened gradually and at a uniform rate so that gasket compression is uniform.

D. Restrained Joints. Restrained joints and anchoring joints shall be installed in strict accordance with the pipe manufacturer's recommendations. Use Certa-Lok restrained joint pipe or approved equal. See Standard Detail Drawing.

5006 CONNECTION TO EXISTING MAINS. The Contractor shall furnish all fittings necessary to join the existing and new water mains as shown on the plans. Contractor shall coordinate with the City on installation procedures and

Tie-ins to minimize down time. The City of Branson requires at least 72 hours' notice from the Contractor in order to notify existing customers before shutting off water.

The City shall provide the meter and standard meter pit. If a vault is required, the contractor and owner shall provide according to the specifications.

5007 POLYETHYLENE ENCASEMENT.

A. General. Polyethylene encasement shall be installed on ductile-iron pipe and fittings when indicated on the plans.
B. Installation. The polyethylene encasement shall be installed as specified in "Method A "or "Method B" below.

1. Method A: Polyethylene tubing shall be approximately two feet (2') longer than the length of the pipe section to provide a one foot (1') overlap on each adjacent pipe section. Tube ends need not be taped in place unless Contractor is directed to do so by the Engineer.

2. Method B. Polyethylene tubing shall be 1 foot shorter than the length of the pipe section with a three foot (3') length of polyethylene tube center over pipe joint and lapped over pipe section and its tubing. Tube ends need not be taped in place unless the Contractor is directed to do so by the Engineer.

3. Repairs. Any rips, punctures, or other damages to the polyethylene shall be repaired with adhesive tape or with a short length of polyethylene tube cut open, wrapped around the pipe, and secured with adhesive tape.

5008 SETTING VALVES, FITTINGS AND HYDRANTS.

A. Valves and Fittings. All valves, fittings, plugs and caps shall be set and joined to the pipe in the manner heretofore specified for cleaning, laying and joining pipe, except that large valves

may require special support so that the pipe will not be required to support the valve weight. Each valve shall be inspected before installation to ensure that all foreign substances have been removed from within the valve body, and shall be opened and closed to see that all parts are in first-class working condition. Gate valves shall be set vertical in the horizontal pipeline. Valves and pipe shall be supported in such a manner as to prevent stress in either with no deflection in the valve/pipe joint.

Valve boxes and lids shall be installed at each valve and shall be supported and maintained centered and plumb over the operating nut of the valve. The valve box shaft shall not transmit shock or stress to the valve. Install valve box covers flush with the surface of the finished area or as directed by the Engineer.

All bends and tees shall be provided with thrust blocks of plain concrete, as specified. All dead ends on new mains shall have a flushing assembly or fire hydrant suitably restrained to prevent blowing off under test pressure.

B. Hydrants. All new hydrant installations shall be as shown on the plans or Standard Detail Drawings and shall include all necessary excavation and backfill to complete the installation.

Each hydrant shall be inspected before installation for direction of opening, nozzle size and threading, nozzle caps and chains, operating nut, and cap nut dimensions, tightness of pressure-containing bolting, cleanliness of inlet elbow and weep hole openings, and handling damage and cracks. Defective hydrants shall be corrected or replaced.

Additionally, all hydrants shall:

- Stand plumb
- The weep holes of the hydrant shall be kept clear and free to drain.
- The areas around each hydrant and hydrant valve shall be thoroughly compacted to prevent settlement of these areas.
- Hydrants shall be set to a grade that allows their proper operation.
- Traffic hydrants with breakaway joint must be set with the joint above the ground line.
- Hydrants behind curbs shall be placed with the hydrant centerline at least 24 inches from the back of curb.
- Hydrants shall be rotated so as to have the pumper nozzle facing the street or rotated to face any direction as required by the Fire Code Official.

## 5009 THRUST RESTRAINTS.

A. Hydrants. The back of the base elbow of each hydrant shall be braced against a sufficient area of unexcavated earth or rock with a concrete thrust block or be restrained by suitable restrained joints as shown on the plans or the Standard Detail Drawing.

B. Fittings. All plugs, caps, tees, bends and other fittings, unless otherwise specified, shall be provided with reaction blocking or suitable restrained joints as shown on the plans or

Standard Drawings.

C. Thrust Blocks. Vertical and horizontal reaction blocking shall be concrete as specified herein. Thrust blocks shall be installed between solid ground and the fitting to be restrained. Concrete shall be located to contain the resultant thrust force and permit access to pipe and fitting joint for repairs. Concrete shall remain off nuts, fittings, and weep holes. All restraining rods, bolts and nuts shall be stainless steel.

## 5010 BACKFILL

### 5010.1 Trench Backfill

A. General. Compacted backfill shall be required for the full depth of the trench above the embedment where beneath structures, street, road, or highway right-of-way, driveways, walks, parking areas, and at all locations shown on the plans or as directed by the Engineer during the progress of the work.

The top portion of the backfill beneath established sodded areas shall be finished with at least 12 inches of topsoil corresponding to, or better than, that underlying adjoining sodded areas. Topsoil shall be approved by the Engineer prior to placement, and unless otherwise directed, shall be material previously excavated and stockpiled for the purpose during excavating and grading operations. Grades on areas to receive topsoil shall be established and maintained as a part of the grading operations. Immediately prior to dumping and spreading topsoil, the surface shall be loosened by discing or scarifying to a depth of two inches (2") to permit bonding of the topsoil to the underlying surface.

The method of compaction and the equipment used shall be appropriate for the material to be compacted and shall not transmit damaging shocks to the pipe.

Backfill shall not be placed when material contains frost, is frozen, or a blanket of snow prevents proper compaction. Backfill shall not contain waste material, organic material, or debris of any kind.

Trench backfill above pipe embedment in locations other than those specified shall be compacted to 90% of the maximum density at optimum moisture content as determined by ASTM D698, unless otherwise permitted by the Engineer.

Pipe embedment material for compacted backfill shall comply with this chapter.

B. Job-Excavated. At the option of the Contractor, compacted backfill may be job-excavated material or graded gravel, except that all street crossings shall be backfilled with graded gravel four feet (4') back of curb to four feet (4') back of curb. Job-excavated material may be used for compacted backfill when the job-excavated material is finely divided and free from debris, organic material, cinders, or other corrosive material, and stones larger than three inches (3") in greatest dimension. Large masses of moist, stiff clay shall not be

used. Job-excavated material shall be compacted to 95 percent of maximum density at optimum moisture content as determined by ASTM D698 when the test is appropriate, or to 70 percent relative density as determined by ASTM D4253 when that test is appropriate.

C. Uncompacted Earth. Uncompacted earth backfill material to be placed above embedments shall be free of brush, roots more than two inches (2") in diameter, debris, cinders, or other corrosive material, but may contain rubble and detritus from rock excavation, stones, and boulders in certain portions of the trench depth. Uncompacted backfill material above embedments may be placed by any method acceptable to the Engineer which will not impose excessive concentrated or unbalanced loads, shock, or impact on and which will not result in displacement of installed pipe. Uncompacted backfill shall be placed to the extent necessary to prevent excessive future settlement.

Compact masses of stiff clay or other consolidated material more than one (1) cubic foot in volume shall not be permitted to fall more than five (5) feet into the trench unless cushioned by at least two feet (2') of loose backfill above pipe embedment.

No uncompacted trench backfill material containing rocks, or rock excavation detritus, shall be placed in the upper 18 inches of the trench except with specific permission of the Engineer, nor shall any stone larger than eight inches (8") in its greatest dimension be placed within three feet (3') of the top of pipe. Large stones may be placed in the remainder of the trench backfill only if well separated and so arranged that no interference with backfill settlement will result.

5010.2 Structure Backfill. Backfill around structures shall be compacted to the extent necessary to prevent future settlement by tamping or other means acceptable to the Engineer.

Material for backfill shall be composed of earth only and shall contain no wood, grass, roots, broken concrete, stones, trash, or debris of any kind. No tamped or otherwise mechanically-compacted backfill shall be deposited or compacted in water.

No backfill shall be placed over or around any structure until the concrete or mortar therein has attained a minimum strength of 2000 psi and can sufficiently support the loads imposed by the backfill without damage.

The Contractor shall use utmost care to avoid any wedging action between the side of the excavation and structure that would cause any movement of the structure. Any damage caused by premature backfill or by the use of equipment on or near a structure is the responsibility of the Contractor.

Backfill shall be placed and compacted on all sides of the structure simultaneously, and operations shall be so conducted that the backfill is approximately the same elevation on all sides of the structure.

No excavated rock larger than four inches (4") maximum dimension shall be placed within one

foot (1') of the exterior surface of any structure.

5010.3 Protection of Trench Backfill. Where trenches are constructed in ditches or other water courses, backfill shall be protected from surface erosion.

When the grade of the ditch exceeds 1 percent, ditch checks shall be installed. Unless otherwise shown on the drawings or directed by the Engineer, ditch checks shall be concrete. Ditch checks shall extend not less than two feet (2') below the original ditch or water course bottom for the full bottom width and at least 18 inches into the side slopes and shall be at least 12 inches thick.

5011 DENSITY TESTING. At the option of the Engineer, in-place field density testing to determine compliance with specified compaction requirements may be performed using a nuclear moisture-density measuring device. If, as a result of this field testing, the engineer determines that further compaction is required, the Contractor shall revise his compaction procedures to obtain the results specified.

5012 DRAINAGE MAINTENANCE. Trenches across roadways, driveways, walks, or other traffic ways adjacent to drainage ditches or water courses shall not be backfilled prior to completion of backfilling the trench on the upstream side of the traffic way, to prevent impounding water after the pipe has been laid. Bridges and other temporary structures required to maintain traffic across such unfilled trenches shall be constructed and maintained by the contractor. Backfilling shall be done so that water will not accumulate in unfilled or partially filled trenches. All material deposited in roadway ditches or other water courses crossed by the line of trench shall be removed immediately after backfilling is completed and the original section, grades, and contours of ditches or water courses shall be restored. Surface drainage shall not be obstructed longer than necessary.

5013 DISPOSAL OF EXCESS EXCAVATED MATERIALS. Except as otherwise permitted, all excess excavated materials shall be disposed of away from the site of work. Broken concrete and other debris resulting from pavement or sidewalk removal, excavated rock in excess of the amount permitted to be and actually installed in trench backfill, and debris encountered in excavation work and other similar waste materials shall be disposed of away from the site of the work.

Excess earth from excavations located in unimproved property shall be distributed directly over the pipe trench and within the pipeline right-of-way to a maximum depth of six inches (6") above the original ground surface elevation at and across the trench and sloping uniformly. Drag with blade machine, or other suitable tool to a smooth, uniform surface without obstructing drainage at any point. Wasting of excess excavated material in the above manner will not be permitted where the line of trench crosses or is within a railroad, public road, or highway right-of-way. The disposal of waste and excess excavated materials, including hauling, handling, grading, and surfacing shall be a subsidiary obligation of the contractor and no separate payment will be made therefore.

5014 SETTLEMENT. The contractor shall be responsible for all settlement of backfill, fills and

embankments which may occur within two (2) years of time after final acceptance of the contract under which the work was performed.

A suitable maintenance bond in an amount approved by the director of public works/engineering shall be furnished to the City by the contractor guaranteeing the maintenance of the construction under which the contract was performed. Said bond shall remain in effect for the period mentioned above from the date of completion and acceptance of the work by the City.

## 5015. DISINFECTION AND TESTING.

A. Disinfection. After installation, the entire main shall be flushed, disinfected by chlorination and bacteriologically tested. Flushing shall be carried out until a turbidity-free water is obtained from all points along the main.

Immediately prior to disinfection, the main to be disinfected shall be flushed at the maximum velocity which can be developed. The flushing velocity shall be at least three feet per second (3 ft./s).

All flushing work shall be done in the presence of the city personnel. The contractor shall notify the city at least 72 hours in advance of the times and places at which flushing work is to be done.

1 Chlorination by the Contractor shall conform to AWWA C651 and be performed using a one percent (1%) chlorine solution prepared from granular calcium hypochlorite (1 pound of HTH per 8 gallons of water). Water entering the new main shall receive a dose of the chlorine solution fed at a constant rate such that the water will have not less than 25 mg/l free chlorine.

Chlorine Required to Produce 25 mg/l
Concentration in 100 feet or Pipe

| Pipe Diameter | 1 Percent Chlorine Solution |
|---|---|
| in. | Gal. |
| 4 | 0.16 |
| 6 | 0.36 |
| 8 | 0.65 |
| 10 | 1.02 |
| 12 | 1.44 |

2. The chlorinated water shall be retained in the main for at least 24 hours, during which time all valves and hydrants in the section treated shall be operated in order to

disinfect the appurtenances.

3. At the end of the 24-hour period, the treated water in all portions of the main shall have a residual of not less than 10 mg/l free chlorine.

4 Mains shall be flushed prior to placing in service. The water shall be disposed of without damage to public or private property.

5. After final flushing and before the new water main is connected to the distribution system, two consecutive sets of acceptable samples, taken at least 24 hours apart, shall be taken from the new main and tested by the City for bacteria. No less than three (3) sample points shall be installed on any water main. Locations shall be as follows:

   a. Within 50 feet of the beginning of the pipeline, mid-way in the pipeline, and within 50 feet of the end of the Pipeline.

   b. For line length longer than 2,500 feet, sample points shall be located every 1,000 feet in addition to the locations at the beginning and end of the line.

6 The contractor shall repeat disinfection procedure should initial treatment fail to yield satisfactory results.

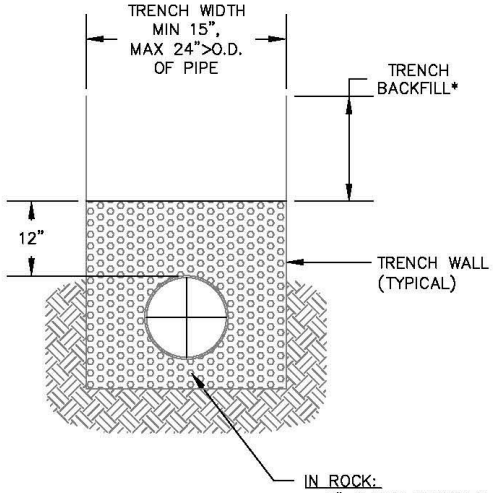
B. Hydrostatic Testing. The Contractor shall perform hydrostatic pressure and leakage tests in accordance with AWWA C600 procedures. Where practicable, mains shall be tested in lengths between line valves or plugs of no more than 1,500 feet in length. conduct test at a pressure of 150 psi measured at the highest point of the main. Duration of the test shall be not less than two (2) hours.

Lines which fail to meet test shall be repaired and retested as necessary until the test requirements are met.

*TRENCH BACKFILL:

1. UNDER PAVED SURFACE
   - ¾" TO 1" CLEAN CRUSHED ROCK FROM 4' BACK-OF-CURB TO 4' BACK-OF-CURB

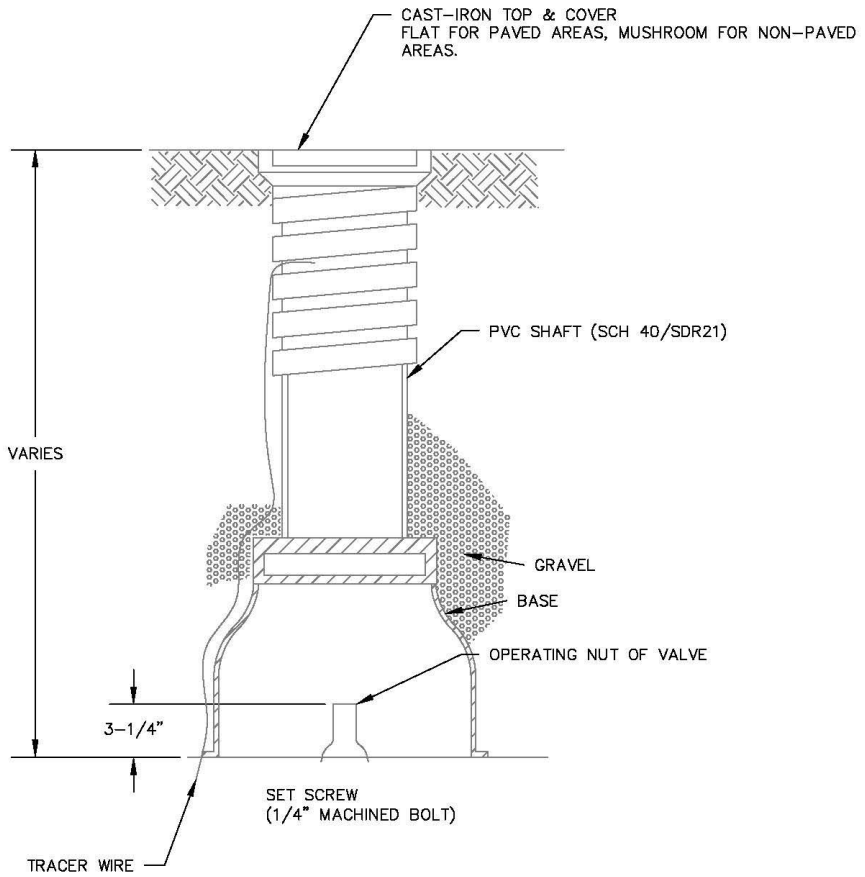
2. OUTSIDE PAVED SURFACE
   - WITHIN R/W
     JOB EXCAVATED MATERIAL COMPACTED TO 95% OF MAX. DENSITY.
   - OUTSIDE R/W
     JOB EXCAVATED MATERIAL COMPACTED TO 90% OF MAX. DENSITY.



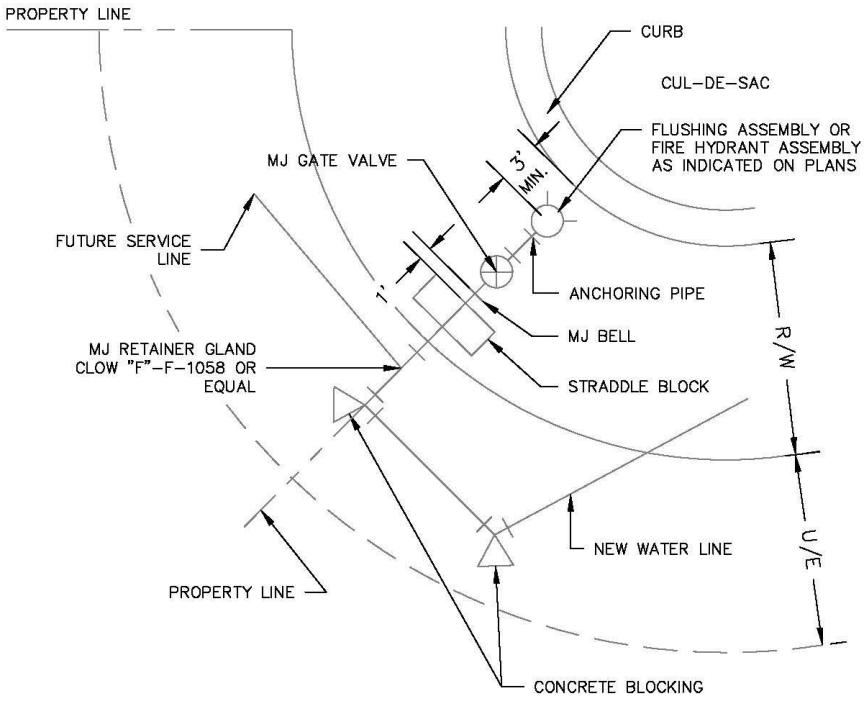

IN ROCK:
- 6" CLEAN CRUSHED ROCK EMBEDMENT

IN EARTH:
- D.I.P. PIPE ON FLAT BOTTOM TRENCH WITH BELL HOLES.
- PVC TO HAVE 6" CLEAN CRUSHED ROCK EMBEDMENT

| Branson MISSOURI ★ Engineering & Public Works | EMBEDMENT AND BACKFILL FOR WATER MAINS | STANDARD DRAWING 50-1 | |
|---|---|---|---|
| | | ADOPTED 2023 | REVISION |

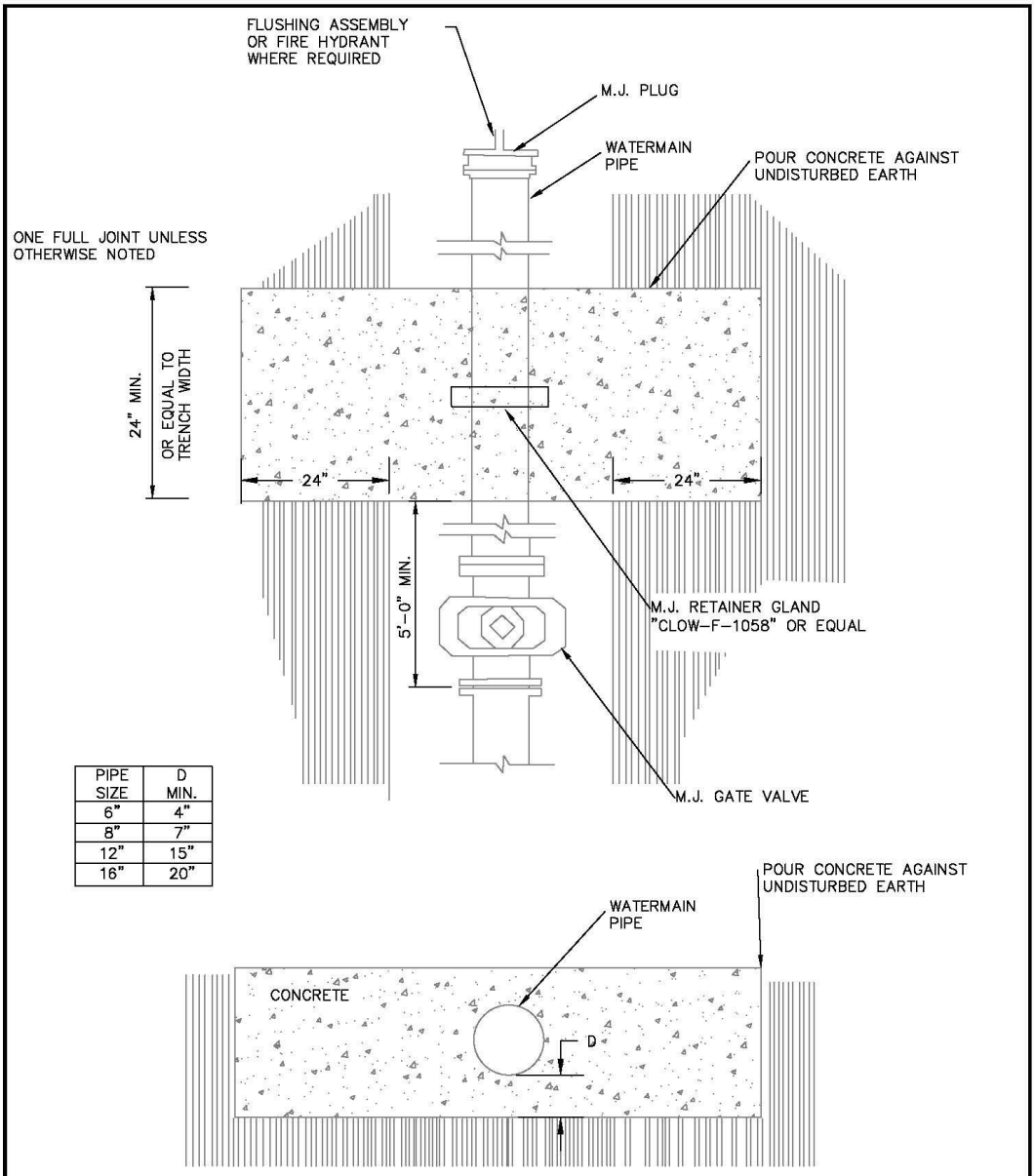


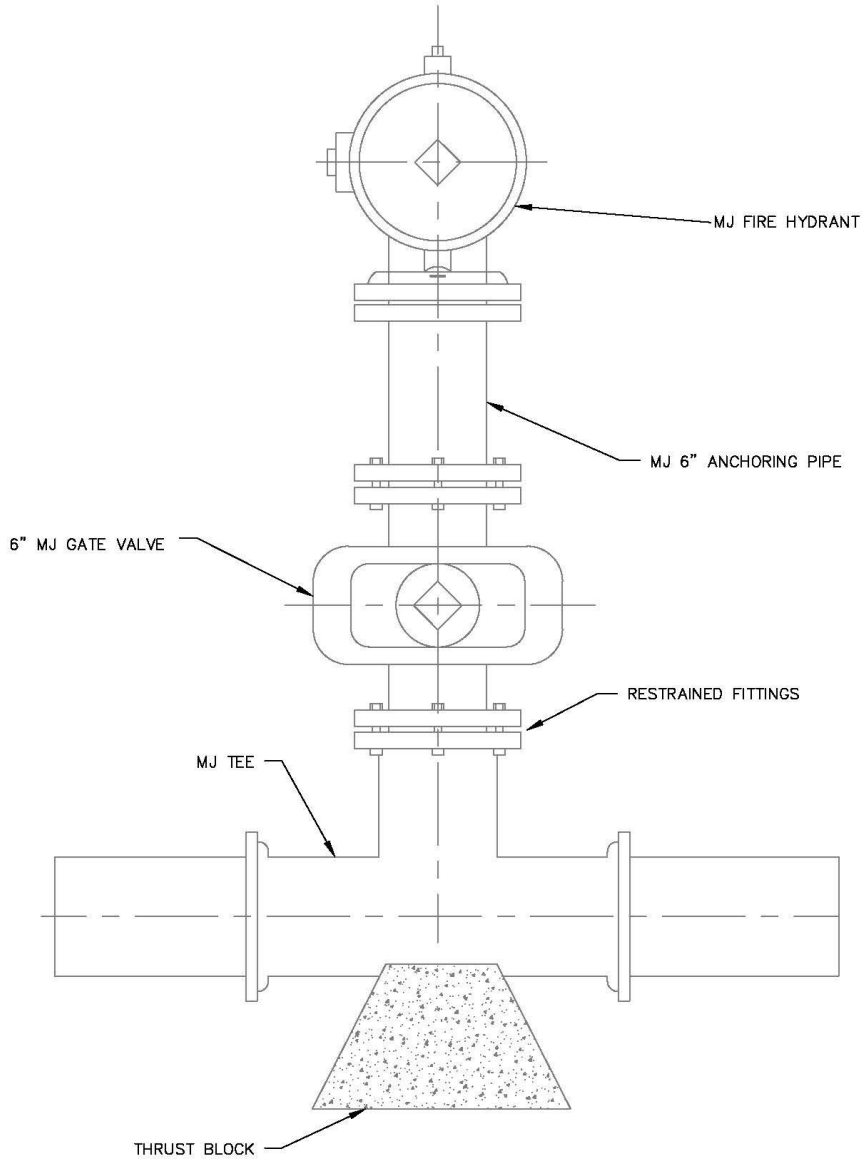

| | | | |
|---|---|---|---|
| Branson MISSOURI Engineering & Public Works | VALVE BOX DETAIL | STANDARD DRAWING 50-2 | |
| | | ADOPTED 2023 | REVISION |



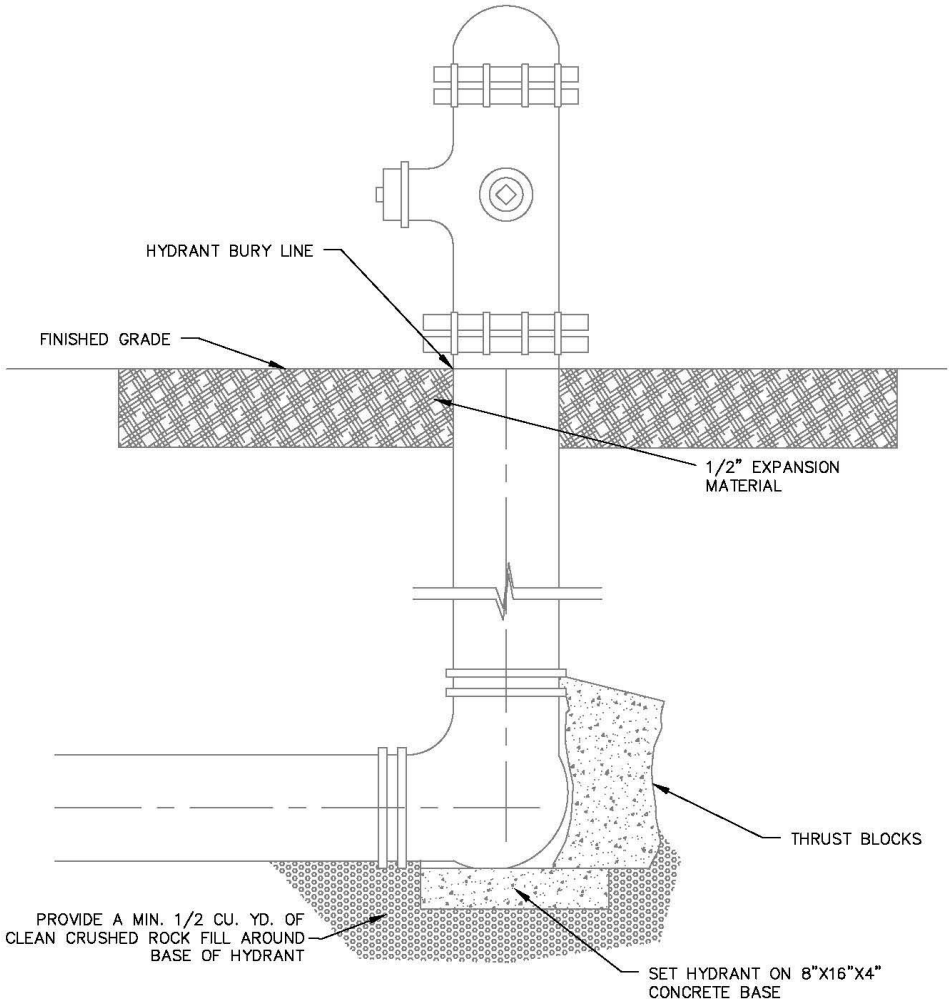

NOTE:
1. USE MJ ANCHOR PIPE AND FITTINGS BEYOND THE STRADDLE BLOCK.
2. ALIGNMENT OF NEW WATER LINE AROUND CUL–DE–SAC VARIES TO MAINTAIN CLEARANCE FROM SANITARY SEWER.
3. MAIN TO BE EXTENDED TO INSURE NEW WATER LINE IS LOCATED LINE FOR FUTURE TAPPING PURPOSES.

| Branson MISSOURI ★ Engineering & Public Works | END OF LINE ON CUL-DE-SAC | STANDARD DRAWING 50-3 | |
|---|---|---|---|
| | | ADOPTED 2023 | REVISION |


FLUSHING ASSEMBLY
OR FIRE HYDRANT
WHERE REQUIRED
M.J. PLUG
WATERMAIN
PIPE
POUR CONCRETE AGAINST
UNDISTURBED EARTH
ONE FULL JOINT UNLESS
OTHERWISE NOTED
24" MIN.
OR EQUAL TO
TRENCH WIDTH
24"
24"
5'-0" MIN.
M.J. RETAINER GLAND
"CLOW-F-1058" OR EQUAL
M.J. GATE VALVE
PIPE SIZE
D MIN.
6" 4"
8" 7"
12" 15"
16" 20"
POUR CONCRETE AGAINST
UNDISTURBED EARTH
WATERMAIN
PIPE
CONCRETE
D
Branson
MISSOURI
Engineering & Public Works
DEAD END
LINE ASSEMBLY
STANDARD DRAWING 50-4
ADOPTED
2023
REVISION

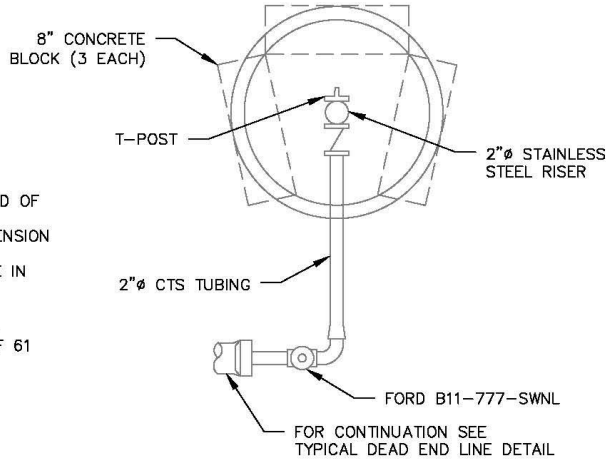



| | | |
|---|---|---|
| Branson MISSOURI ★ Engineering & Public Works | TYPICAL FIRE HYDRANT INSTALLATION DETAIL (UP TO 20' FROM MAIN) | STANDARD DRAWING 50-5 |
| | | ADOPTED 2023 / REVISION |

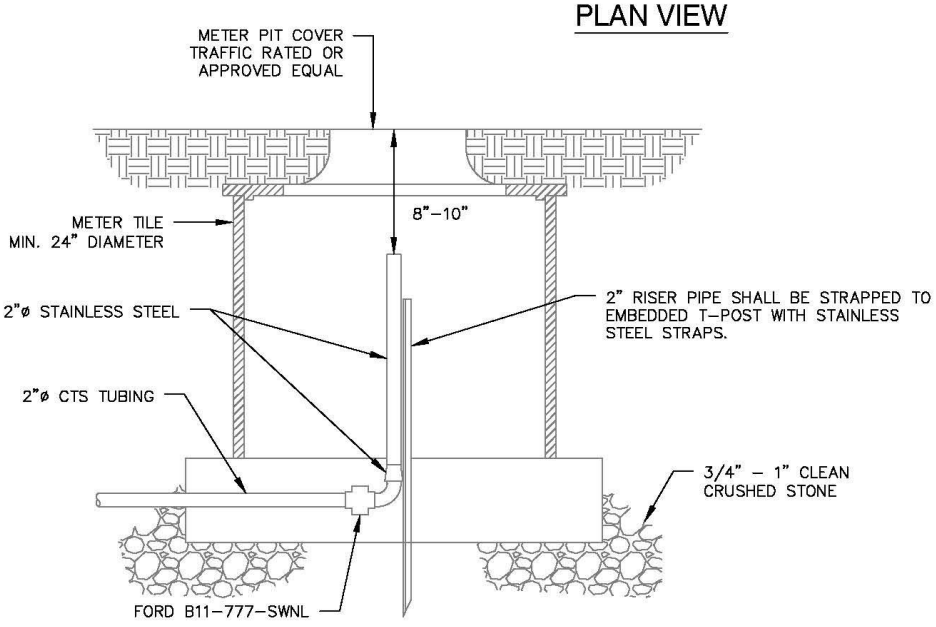



| | | | |
|---|---|---|---|
| Branson MISSOURI ★ Engineering & Public Works | FIRE HYDRANT ASSEMBLY DETAIL | STANDARD DRAWING 50-5 | |
| | | ADOPTED 2023 | REVISION |

NOTES:
1. WHERE MAIN IS LOCATED BEHIND CURB IN STREET, R/W, OR EASEMENT, FLUSHING ASSEMBLY MAY BE CONSTRUCTED OVER END OF LINE WITHOUT OFFSET AS SHOWN.
2. ASSEMBLY TO BE USED ON NEW MAIN EXTENSION WHERE MAIN IS WITHIN PAVED SURFACE, SHOULDER OR IN DITCH LINE. LOCATE TILE IN ESTABLISHED GRADE AREA.
3. SET 5'–0" STEEL POST NEAR BLOW OFF ASSEMBLY AS AN ABOVE GROUND MARKER.
4. ALL FITTINGS AND PIPING SHALL BE 2" NSF 61 COMPLIANT.




PLAN VIEW

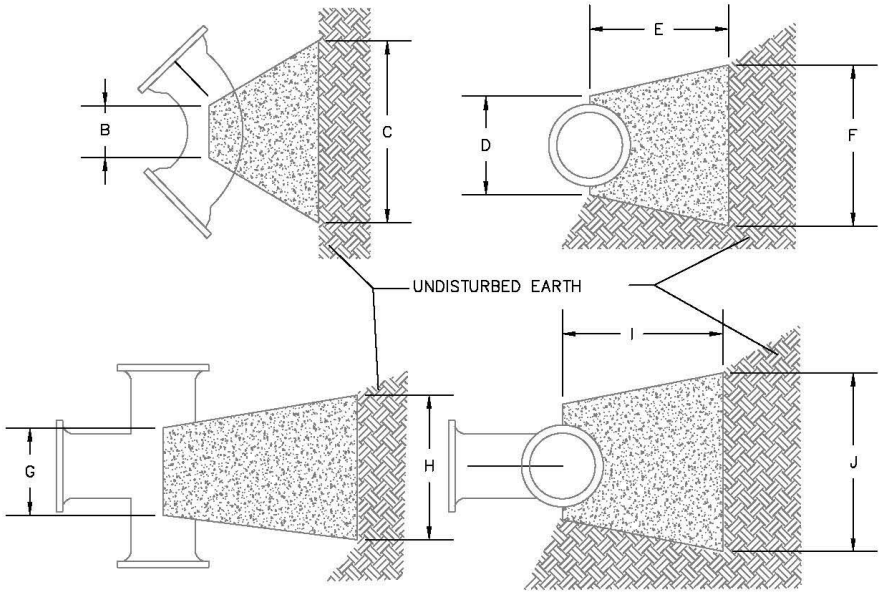



ELEVATION VIEW

| | | | |
|---|---|---|---|
| Branson MISSOURI Engineering & Public Works | FLUSHING ASSEMBLY DETAIL | STANDARD DRAWING 50-6 | |
| | | ADOPTED 2023 | REVISION |

| BENDS | B | C | D | E | F | BENDS | B | C | D | E | F |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 6" 11 1/4 DEG 8" | | 15" | 12" | 24" | 12" | 6" 45 DEG | 8" | 30" | 12" | 24" | 14" |
| 6" 22 1/2 DEG 8" | | 19" | 12" | 24" | 24" | 6" 90 DEG | 8" | 30" | 12" | 24" | 27" |
| 8" 11 1/4 DEG 8" | | 20" | 12" | 24" | 12" | 8" 45 DEG | 8" | 30" | 12" | 24" | 24" |
| 8" 22 1/2 DEG 8" | | 22" | 12" | 24" | 17" | 8" 90 DEG | 8" | 36" | 12" | 24" | 36" |
| 12" 11 1/4 DEG 8" | | 30" | 12" | 24" | 12" | 12" 45 DEG | 8" | 40" | 12" | 24" | 40" |
| 12" 22 1/2 DEG 8" | | 35" | 12" | 24" | 25" | 12" 90 DEG | 8" | 60" | 12" | 24" | 52" |
| | | | | | | | | | | | |

| TEES | G | H | I | J | | TEES | G | H | I | J | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 6"X 6"X 6" | 12" | 24" | 24" | 18" | | 12"X12"X6" | 12" | 24" | 24" | 18" | |
| 8"X 8"X 6" | 12" | 24" | 24" | 18" | | 12"X12"X8" | 12" | 24" | 24" | 24" | |
| 8"X 8"X 8" | 12" | 24" | 24" | 24" | | 12"X12"X12" | 12" | 36" | 24" | 36" | |



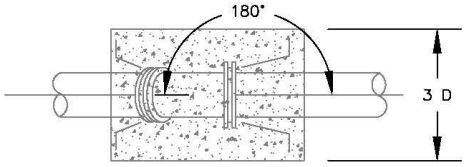

Branson MISSOURI
Engineering & Public Works

CONCRETE BLOCKING DETAIL

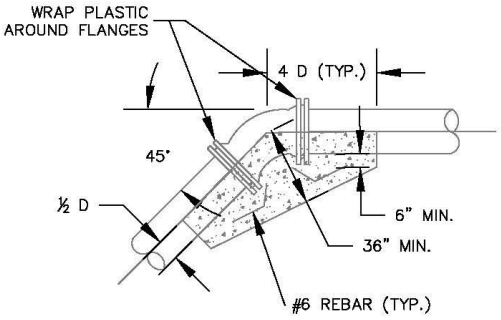
STANDARD DRAWING 50-7

ADOPTED 2023

REVISION




PLAN




ELEVATION

## ○ MATERIAL LIST

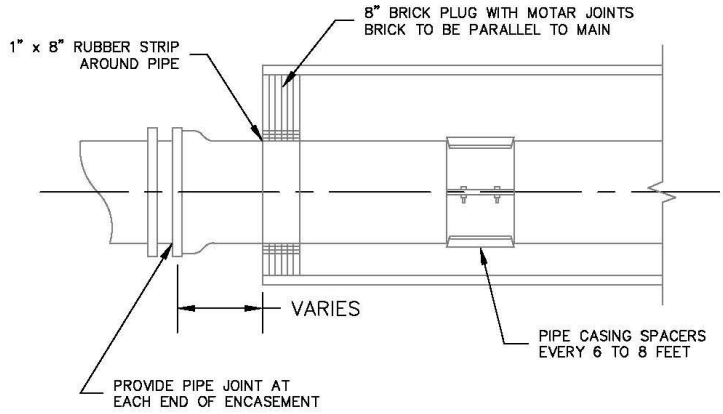
1. PVC PIPE OR DI PIPE
2. MJ SOLID SLEEVE
3. DI PIPE
4. CONCRETE THRUST COLLAR W/RETAINER GLANDS
5. MAINS SIZE X 45 DEGREE BENDS W/RETAINER GLANDS

## △ GENERAL NOTES

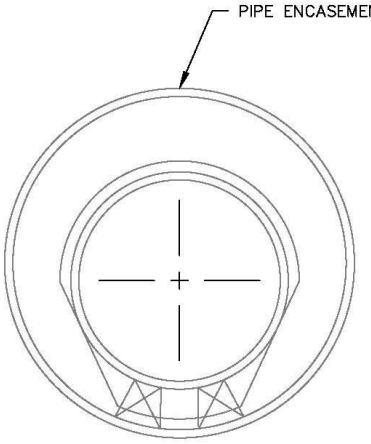
1. FULL 16' SECTION OF PIPE
2. CONSTRUCT THIS SECTION OF PROJECT A MINIMUM OF 24 HRS BEFORE MAKING TIE-IN.
3. THIS METHOD OF INSTALLATION IS ALSO AN ACCEPTABLE STANDARD WHEN USING LESS THAN 45 DEGREE BENDS.

NOTE: RETAINER GLANDS WILL BE USED ON ALL VERTICAL BENDS

| | | | |
|---|---|---|---|
| Branson MISSOURI ★ Engineering & Public Works | VERTICAL BEND BLOCKING DETAIL | STANDARD DRAWING 50-8 | |
| | | ADOPTED 2023 | REVISION |




SECTION




SECTION

| | | | |
|---|---|---|---|
| Branson MISSOURI ★ Engineering & Public Works | PIPE ENCASEMENT DETAIL | STANDARD DRAWING 50-9 | |
| | | ADOPTED 2023 | REVISION |

ALLOWABLE LEAKAGE PER 1,000 FEET OF PIPELINE *-gph
NOMINAL PIPE DISMETER (INCHES)

| AVERAGE TEST PRESSURE (PSI) | 4 | 6 | 8 | 10 | 12 | 14 | 16 | 18 | 20 | 24 | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 300 | 0.52 | 0.78 | 1.04 | 1.30 | 1.56 | 1.82 | 2.08 | 2.34 | 2.60 | 3.12 | |
| 275 | 0.50 | 0.75 | 1.00 | 1.24 | 1.49 | 1.74 | 1.99 | 2.24 | 2.49 | 2.99 | |
| 250 | 0.47 | 0.71 | 0.95 | 1.19 | 1.42 | 1.66 | 1.90 | 2.14 | 2.37 | 2.85 | |
| 225 | 0.45 | 0.68 | 0.90 | 1.13 | 1.35 | 1.58 | 1.80 | 2.03 | 2.25 | 2.70 | |
| 200 | 0.43 | 0.64 | 0.85 | 1.06 | 1.28 | 1.48 | 1.70 | 1.91 | 2.12 | 2.55 | |
| 175 | 0.40 | 0.59 | 0.80 | 0.99 | 1.19 | 1.39 | 1.59 | 1.79 | 1.98 | 2.38 | |
| 150 | 0.37 | 0.55 | 0.74 | 0.92 | 1.10 | 1.29 | 1.47 | 1.66 | 1.84 | 2.21 | |
| 125 | 0.34 | 0.50 | 0.67 | 0.84 | 1.01 | 1.18 | 1.34 | 1.51 | 1.68 | 2.01 | |
| 100 | 0.30 | 0.45 | 0.60 | 0.75 | 0.90 | 1.05 | 1.20 | 1.35 | 1.50 | 1.80 | |

*FOR PIPE WITH 18-FOOT NOMINAL LENGTHS, TO OBTAIN THE RECOMMENDED ALLOWABLE LEAKAGE FOR PIPE WITH 20-FOOT LENGTHS, MULTIPLY THE LEAKAGE CALCULATED FROM THE TABLE BY 0.0. IF THE PIPELINE UNDER TEST CONTAINS SECTIONS OF VARIOUS DIAMETERS, THE ALLOWABLE LEAKAGE WILL BE THE SUM OF THE COMPUTED LWAKAGE FOR EACH SIZE.

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ALLOWABLE LEAKAGE FOR WATER LINES

STANDARD DRAWING 50-10

| ADOPTED | REVISION |
|---|---|
| 2023 | |

SECTION 6000 TUNNELING, BORING AND JACKING (PIPELINES)

6001 SCOPE. This section governs construction of steel casings, complete with bulkheads and sand fill, by boring and/or jacking at the locations and to the lines and grades indicated on the drawings directed by the Engineer, or where constructed at the contractor's option, when approved, to bypass obstructions without open cutting.

6002 MATERIALS.

A. Steel Liner Plate. Steel tunnel liner plates shall be Armco "Standard", Commercial Shearing and Stamping Company "Commercial", Republic "Truscon Paneled Out", or equal and shall be galvanized in accordance with ASTM A123. The design and shape of the liner plates shall be such that assembly can take place entirely from within the tunnel liner. Sufficient sections shall be provided with one and one-half inch (1 ½") or larger grouting holes, located near the centers, so that when the plates are installed there will be one line of holes on either side of the tunnel and one at the crown. The holes in each line shall not be more than nine feet (9') apart and, unless otherwise approved, shall be staggered. Bolts and nuts shall conform to ASTM A153, A307, A325 and A449 as applicable.

B. Steel Casing.

1. Steel casing for bored or jacked construction shall conform to ASTM A139.

2. Steel shall be grade B under railroads and grade A for all other uses.

3. Minimum wall thickness for steel casing shall be in accordance with the following table:

| Diameter of Casing | Under Railroads | All Other Uses |
|---|---|---|
| 24" | 0.406" | 0.281" |
| 26" | 0.438" | 0.281" |
| 28" | 0.469" | 0.312" |
| 30" | 0.469" | 0.312" |
| 32" | 0.500" | 0.312" |
| 34" | 0.500" | 0.312" |
| 36" | 0.500" | 0.312" |

4. Casing joints shall be welded by a certified welder in accordance with AWWA C206.

C. End Seals. End seals shall be brick conforming with Section 20.2(D) of these specifications. Mortar shall comply with Section 20.2(E) of these specifications. End seals must be bolt together J-Four Model 60 or approved equal.

D. Sand Fill. Sand fill shall comply with ASTM C33 or MCIB Section 4, Fine Aggregate. Moisture content of the sand shall not exceed 0.5%.

6003 CONSTRUCTION DETAILS.

A. General.

1. Prior to starting work, complete details of the method of operation and liner materials to be used shall be submitted to the Engineer. The pipe line, in the area to be tunneled, bored or jacked, shall be completed before the construction of adjacent portions of the same pipe line. The purpose of this requirement is to allow for slight discrepancies in alignment and grade which may occur in the tunneled, bored or jacked installation, so minor adjustments in the adjacent pipe can be made.

2. The maximum allowable deviation from plan alignment and grade shall be as follows except when altered by the Plans or Special Provisions:

a . Alignment 1.0%
b. Grade 1.0%

B. Casing Installation.

1. The steel casing shall be advanced in a continuous operation without interruption. Sections of the casing pipe shall be welded together to form a continuous conduit capable of resisting all stresses, including jacking stresses. The casing in its final position shall be within alignment and grade tolerances specified in Section 6003 (A)(2). There shall be no space between the earth and the outside of the casing. Any voids which do occur shall be filled by pressure grouting.

2. Boring operations shall be performed by experienced crews using a rotary type boring machine designed especially for this purpose. Boring shall be performed in a manner to prevent disturbing the overlying and adjacent materials.

3. Jacking.

a. Jacking frame, guides, blocking, head and reaction devices shall be arranged to apply uniform pressure about the casing circumference without damage to the casing material, and to maintain alignment within specified tolerances.

b. Jacking reaction device shall provide adequate resistance to withstand 200 percent of the maximum jacking pressure.

c. Provide jacks of adequate number and size for the required jacking pressure; but not less than two jacks.

d. Maintain jacking pit and pipe installation in such condition that drainage does not accumulate. Control and disposition of surface and subsurface water at the site of jacking operations shall be the Contractor's

responsibility subject to the approval of the Engineer.

e. Excavation of the heading shall not be extended more than one inch (1") outside the top and sides (upper 300-degree sector) of the casing and shall be true to grade at the invert (lower 60-degree sector).

f. Once jacking begins, it shall proceed without interruption until installation of the entire length of the jacked line is complete.

4. Excavation in Jacked Casings. Perform excavation within jacked casings by hand or machine methods as necessary to remove the materials encountered without disturbing the overlying material. The jacked casing shall be advanced a sufficient distance ahead of the excavation face and/or shield used as necessary to protect the workman and the work, and to prevent the uncontrolled entry of unstable materials into the casing.

5. Unstable Materials. If materials are encountered during casing installation that cannot be excavated safely or without creating voids around the exterior of the casing, the Contractor shall discontinue casing installation and stabilize such materials by dewatering, chemical soil stabilization, grouting, or other methods, and/or modify equipment and procedures as necessary to complete the casing installation.

C. Lining Installation.

1. Excavation. Excavate by approved methods applicable to materials encountered. Boring operations shall be performed by experienced crews using a rotary type boring machine designed especially for this purpose. Include dewatering and chemical soil stabilization or grouting when necessary due to existing field conditions. Conduct excavation in a manner to prevent disturbing the overlaying and adjacent material.

2. Lining. Assemble liner plates immediately following the excavation. Advance casing continuously with excavation. When liner plates are being installed, care shall be taken to maintain alignment, grade and circular shape of the tunnel. All voids between liner and surrounding earth shall be filled with grout forced in under pressure. The grout shall consist of two parts of sand to one part of Portland cement, mixed with sufficient water to maintain a freely pouring consistency. As the pumping through any hole is stopped, it shall be plugged to prevent the backflow of grout. After lining installation is complete it shall be cleaned of all debris and all leaks which allow flowing or seeping water into tunnel, shall be stopped.

D. Pipe Installation.

1. Pipe shall be placed inside the casing to the plan line and grade by the use of wood skids or other equivalent methods. The wood shall be pressure treated with creosote,

pentachlorophenol, or salt-type preservative in accordance with AWWA C2. Cut surfaces shall be given two (2) heavy brush coats of the same preservative. The wood skids shall be securely fastened to the pipe with steel straps.

2. End seals shall be constructed after the pipe is installed and approved.

3. In sanitary sewer construction, the annular space between the casing and pipe shall be filled with stabilized sand blown in so that all space is filled without disturbing the alignment and grade of the pipe.

4. No interruption of traffic will be permitted at any location where a tunnel or casing is required.

# SECTION 8000 RESTORATION OF SURFACE CONSTRUCTION

8001 SCOPE This section covers restoration of concrete and asphalt pavement, gravel surfacing, walks, drives, curbs, and other surface construction removed or damaged during construction.

8002 GENERAL. All pavement or other surface construction which is removed or damaged during the progress of the work shall be restored to its original or better condition by the Contractor. All restoration work shall be subject to acceptance by the Engineer and the Owner or the agency having jurisdiction thereof. All materials used for restoration work shall be new.

8003 REFERENCE STANDARD. Materials and construction methods, as referred to herein, shall conform to all applicable sections of these technical specifications.

8004 PAVEMENT REPLACEMENT. The replacement of all street surfacing shall be in accordance with the pavement replacement detail shown on the Standard Detail. The replacement concrete and asphalt pavement shall be composed of a concrete base course at least seven inches (7") thick and an asphaltic concrete overlay at least two inches (2") thick. Materials and workmanship shall conform to the following:

| | |
|---|---|
| Concrete | As specified in Section 2000 |
| Asphaltic Concrete | As specified in Section 1400 |
| Trench Backfill | Graded gravel |

All drives, parking areas, and other pavement or asphalt surfaces which are removed or damaged shall be replaced to at least their original thickness. Materials used shall be new and shall match the existing surfacing as closely as possible in type, kind and quality.

8005 CONCRETE WALKS. Concrete walks removed in connection with, or damaged as a result of, construction operations shall be replaced with new construction. Such walks shall be constructed of concrete on a thoroughly compacted subgrade, shall have a vertical thickness at least as thick as the existing walks, but not less than four inches (4") thick, shall be constructed with expansion joints spaced not exceeding 50 feet apart, and shall be sloped for drainage at right angles to the longitudinal centerline in the amount of approximately one-fourth inch (1/4") per foot of walk width.

Concrete materials and workmanship shall conform to the applicable requirements of Section 2000, "Concrete" of these specifications.

Surface finish of concrete walks replaced shall conform to, and shall match as closely as possible, that of existing concrete walk surfaces.

8006 CONCRETE CURBS AND GUTTERS. Concrete curbs and gutters which have been removed or damaged by reason of construction operations or any other cause shall be replaced with new concrete construction to the nearest expansion joint. New curb and gutter sections

shall be as designated on the drawings and as detailed on the Standard Detail Drawing.

Concrete materials and workmanship shall conform to the applicable requirements of Section 2000.

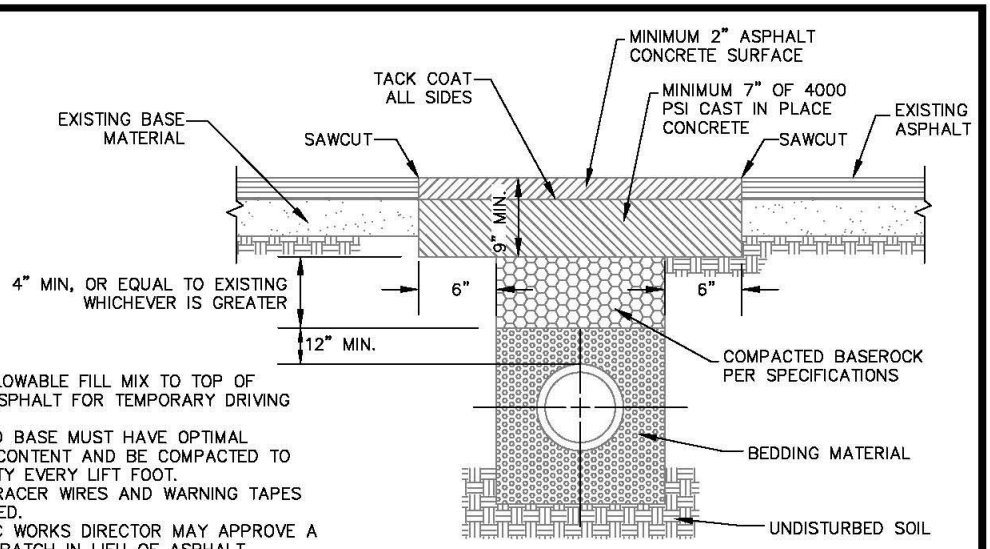
Construction and expansion joints, dimensions, elevations and surface finish of curb and gutter replacements shall conform to, and shall match as closely as possible, that of adjacent existing concrete curbs and gutters.

8007 GRAVEL SURFACING. Existing gravel drives, parking and surfacing which is removed or damaged during the progress of the work shall be replaced with an aggregate surfacing at least as thick as that removed, but in no case less than four inches (4").

New aggregate surfacing shall match existing surfacing as nearly as possible in size, gradation, color, and compaction.

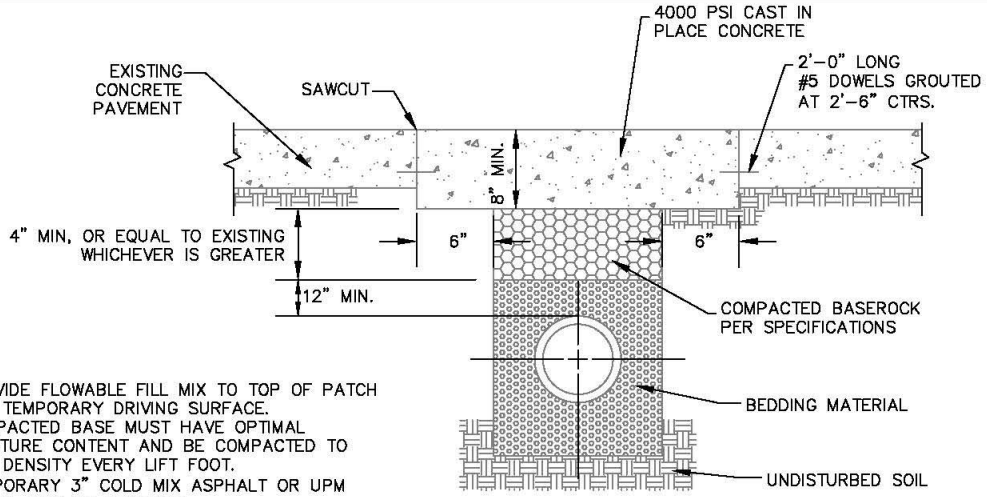
8008 MISCELLANEOUS REPAIR WORK. All existing items and construction, whether or not indicated by the drawings but are removed or damaged as a result of construction operations, shall be repaired or replaced unless otherwise required by the drawings.

Repair or replacement shall be with materials similar to those existing, and shall in each case restore the item to its original or better condition as acceptable to the Engineer and the Owner thereof.




NOTES:
1. PROVIDE FLOWABLE FILL MIX TO TOP OF EXISTING ASPHALT FOR TEMPORARY DRIVING SURFACES.
2. COMPACTED BASE MUST HAVE OPTIMAL MOISTURE CONTENT AND BE COMPACTED TO 95% DENSITY EVERY LIFT FOOT.
3. PROVIDE TRACER WIRES AND WARNING TAPES AS SPECIFIED.
4. THE PUBLIC WORKS DIRECTOR MAY APPROVE A CONCRETE PATCH IN LIEU OF ASPHALT.

## ASPHALT STREET REPAIR
## NOT TO SCALE




NOTES:
1. PROVIDE FLOWABLE FILL MIX TO TOP OF PATCH FOR TEMPORARY DRIVING SURFACE.
2. COMPACTED BASE MUST HAVE OPTIMAL MOISTURE CONTENT AND BE COMPACTED TO 95% DENSITY EVERY LIFT FOOT.
3. TEMPORARY 3" COLD MIX ASPHALT OR UPM PATCH MAY BE REQUIRED.
4. PROVIDE TRACER WIRES AND WARNING TAPE AS SPECIFIED.

## CONCRETE STREET REPAIR
## NOT TO SCALE

| | | | |
|---|---|---|---|
| Branson MISSOURI ★ Engineering & Public Works | STREET PATCH DETAIL | STANDARD DRAWING 80-1 | |
| | | ADOPTED 2023 | REVISION |

SECTION 8100 FENCING

8101 SCOPE. This specification covers the furnishing of all labor, materials and equipment for the installation and removal of fencing and gates as shown on the Plans and Standard Drawings, the specifications and the Special Provisions.

8102 FENCE TYPE. Fencing shall conform to the alignment and details shown on the drawings

Chain-link fence shall consist of galvanized or aluminum-coated steel fabric, steel posts, top rail, and bottom rail or tension wire. Posts shall be set in concrete.

8103 MATERIALS. All materials used for the installation of a permanent chain link fence shall be new material conforming to Section 1043 of the Missouri Standard Specification for highway construction except concrete for posts shall be MCIB Mix No. A543-1-4-0.479, or approved equal.

All material used for the installation of permanent decorative fence shall be new material as specified or as shown on the Plans or that match the existing fence.

8104 GATES. Gates shall be swing type, hinged to swing 90 degrees from closed to open, complete with frames, latches, stops, keepers, hinges, and fabric. Gate leaves shall have intermediate members and diagonal truss rods as required for rigid construction. Joints between frame members shall be made by welding or by means of heavy fittings, and shall be rigid and water tight. Gate fabric shall be same as fence fabric and shall be attached to frame ends by stretcher bars, bolt hooks, or other mechanical means.

Hinges shall be heavy pattern with large bearing surfaces and shall not twist or turn under the action of the gate. Latches shall be plunger bar type, full gate height, and arranged to engage the gate stop, except single gates less than 10 feet wide may be provided with a forked latch. Latches shall be arranged for padlocking with the padlock accessible from both sides of the gate. Stops shall consist of a roadway plate with anchor set in concrete and arranged to engage the plunger. Keepers shall consist of mechanical devices for securing and supporting the free end of gates when in the full-open position.

Gates shall be installed so that they cannot be removed without disassembly of the hardware. Hardware attachment bolts shall be peened so that removal will be difficult.

8105 FENCE CONSTRUCTION.

A. Removal: Existing fence shall be removed as specified or as shown on the Plans or as directed by the Engineer. Removed fencing may be used for temporary fencing only with the Engineer's approval. Fences interfering with construction, and located within public right-of-way or as may be allowed for in permits or agreements, may be removed by the Contractor only if the opening is provided with a temporary gate that will be maintained in a closed position except to permit passage of equipment and vehicles unless otherwise specified. Fences within temporary construction easements may be removed by the Contractor provided that temporary fencing is installed in such a manner as to serve the purpose of the fencing removed. The Contractor shall locate and record all fence corners

prior to removal. All fencing removed shall be restored by the Contractor to a condition equal to or better than that existing prior to construction unless otherwise specified. The Contractor is liable for loss and costs associated with stray animals caused by the removal or improper construction of temporary or permanent fencing.

Chain-Link Fence: Chain-Link Fence shall be installed at the locations shown on the Plans or as directed by the Engineer in accordance the applicable MoDOT specifications for the state where the work is being performed. However, the bottom of the fabric shall be not more than 1 ½ inches above the finished ground line unless shown otherwise on the Plans. All residential fence shall have a top rail and all edges of fence fabric shall be knuckled. The installed fence shall conform to the alignment and finish grade indicated. All posts shall be plumb unless otherwise shown or required shall be spaced 10 feet apart for 6-foot fencing and six feet (6') apart for 42-inch fencing. Where necessary, the fence grade shall be adjusted to fit the ground contour by slipping the fence fabric links. Found surface irregularities shall be graded as required to maintain not more than a two inch (2") clearance below the bottom of the fence fabric.

B. Decorative Fence: Decorative fence shall be installed at the locations shown on the Plans or as directed by the Engineer in accordance with the manufacturer's instructions and recognized industry standards or as directed by the Engineer.

Where posts are set in earth, concrete foundations 36 inches deep shall be provided. If bedrock is encountered, post excavation shall be continued to the 36-inch depth or 18 inches into the rock, whichever is less. Concrete foundation shall be circular in horizontal section, not less than 10 inches in diameter for line posts, and with a diameter not less than the post OD plus nine inches (9") for terminal and gate posts, except that foundations in bedrock shall be a minimum of six inches (6") larger than the outside dimension of the post. Foundations shall extend above the ground surface and shall be crowned approximately one inch (1"). Concrete for foundations shall conform to the requirements of Section 2000 "Concrete". Each foundation shall be cured for at least 72 hours before further work is done on the post.

Top rails and bottom tension wires shall be installed before the fabric. Top rails shall be furnished in at least 18 foot lengths and shall be securely connected to gate and terminal posts. Tension wires shall be installed approximately six inches (6") above grade and shall be attached to each post and securely anchored at terminal and gate posts. Straight runs between braced posts shall not exceed 1,500 feet. A terminal post shall be provided at each change in slope.

Fabric shall be attached to the top rail, bottom rail, and bottom tension wire at 24 inch centers and to the line posts at 15 inch centers. Barbed wire shall be fastened to each extension arm by internal clips or external fabric ties. Each stretcher bar shall be threaded through the fabric and anchored to the post at 15-inch center by positive mechanical means.

Each gate and terminal post shall be braced by horizontal pipe brace and an adjustable

truss extending to an adjacent line post. Corner posts shall be braced in both directions.

Fabrics shall be stretched taut and anchored so that a pull of 150 pounds at the middle of a panel will not lift the bottom of the fabric more than six inches (6").

## 8106 METHOD OF MEASUREMENT

A. Fence shall be measured along the slope of the fence to the nearest linear foot. Vehicle gates shall not be included in this measurement.

B. Gates: Gates shall be measured per each for the size and type specified. C. Temporary Fence:

C. Temporary fence will be measured by one of the following:

1. No measurement made.
2. Per foot measured along the slope to the nearest linear foot.

D. Fence Removal: Fence removal will be measured by one of the following:

1. No measurement made.
2. Per linear foot to nearest foot.

## 8107 BASIS OF PAYMENT

All items in this section will be paid for at the respective Contract unit bid price. There will be no separate payment for pedestrian gates; they are subsidiary to the fencing pay item.

SECTION 8200 SEEDING AND SODDING

8201 SEEDING.

A. Scope. This section governs furnishing all labor, materials and equipment necessary for complete installation of seeding in accordance with the Standard Drawings, the specifications and Special Provisions. The Contractor shall furnish all plants and materials and perform all operations in connection with the preparation, fertilizing, placing, watering, firming and establishment, of seeding areas, complete and in strict accordance with these specifications and applicable Plans, and subject to the terms and conditions of the Contract. The Contractor shall seed disturbed areas where shown on the Plans or by field inspection and as required by the Storm Water Pollution Prevention Plan. The Contractor shall be responsible for establishment of grass.

B. Materials, Definitions and Equipment.

1. Seeds. Seed: Seed shall be labeled in accordance with U.S. Department of Agriculture Rules and Regulations under Federal Seed Act. All seed shall be furnished in sealed standard containers unless exception is granted in writing by the Owner. Seed shall be free from noxious weeds and recleaned "Grade A" recent crop seed treated with appropriate fungicide at time of mixing. Seed which has become wet, moldy, or otherwise damaged in transit or in storage will not be acceptable. Seed mix to be used will be identified prior to sowing. The minimum percentage by weight of pure live seed in each lot of seed shall be as follows:

a. Type "A" Seed. This seeding mixture will normally be used where seeding is required in areas of established yards, shoulders and slopes in street right of way, and any other areas where a high-type seeding is deemed necessary. The seed mixture will be as follows:

| Common and Botanical Name | Minimum Pure Live Seed % | Rate of Pure Live Seed (Pounds per Acre) |
|---|---|---|
| Alta Fescue or Kentucky 31 Fescue (Festuca Elatior) Var. Arundinces | 75 | 100 |
| Rye Grass (Lolium Perenne or L. Multiflorum) | 80 | 25 |
| Kentucky Blue Grass (Pac. Pratensis) | 75 | 15 |
| Creeping Red Fescue (Festuca Rubra) | 85 | 10 |
| Total | | 150 |

b. Type "B" Seed. This seeding mixture will normally be used to seed areas off street rights-of-way that are not maintained.

| Common and Botanical Name | Minimum Pure Live Seed % | Rate of Pure Live Seed (Pounds per Acre) |
|---|---|---|
| Alta Fescue or Kentucky 31 Fescue (Festuca Elatior) Var. Arundinces | 75 | 90 |
| Rye Grass (Lolium Perenne or L. Multiflorum) | 80 | 50 |
| otal(Pac. Pratensis) | 7 | 140 |

c. All seeding work shall be done between the dates of February 1 and April 15 for spring planting or August 15 and October 15 for fall planting. Sowing shall be accomplished by use of an approved mechanical seeder or drill (hand spreader can be used in small areas), making sure that successive seed strips overlap to provide uniform coverage. Seed should be drilled to a depth of 1/2 inch.

2. Inorganic Fertilizer: Inorganic fertilizer shall be composed of a formula 12-12-12, 13-13-13 or other approved substitute, and shall conform to the applicable State fertilizer laws. Fertilizer shall be of a type that can be uniformly distributed by the application equipment. Fertilizer may be furnished in a dry (granulated) or liquid form. When applied dry, the fertilizer shall be a granular, non-burning chemically combined product composed of not less than 50% organic slow acting, guaranteed analysis professional fertilizer. Granular or pellet form shall be uniform in composition, dry and free flowing and shall be delivered to the site in the original unopened containers each bearing the manufacturer's guaranteed analysis. Any fertilizer which becomes caked or otherwise damaged, making it unsuitable for use, will not be accepted. When applied in a liquid form, fertilizer may be chemically combined or may be furnished as separate ingredients.

3. Mulch. Mulch shall be either the vegetative type, wood cellulose fiber type, whichever is specified in the Special Provisions, or as approved by the Engineer.

a. Vegetative Type. The vegetative type shall be the cereal straw from stalks of oaks, rye, wheat or barley and shall be free of prohibited and noxious weed seeds.

b. Wood Cellulose Fiber Mulch. Wood cellulose fiber shall contain no germination or growth inhibiting ingredients, and shall be dyed an appropriate color to aid in visual metering in its application. It shall be easily and evenly dispersed and suspended when agitated in water, and when sprayed uniformly on the soil surface, shall form a blotter like cover, which readily absorbs the water and allows infiltration to the underlying soil. The mulch material shall be supplied in packages of not more than 100 pounds' gross weight, and shall be marked by the manufacturer to show the air dry weight content. (Air dry weight shall contain no more than 10 per cent moisture).

4. Water: Water, hose and other watering equipment required for the work shall be furnished by the Contractor.

5. Other Materials: Other materials not specifically described but required for a complete and proper planting installation, shall be as selected by the Contractor subject to the approval by the Owner.

6. Equipment. The seeding operation shall be accomplished with equipment suitable for preparing the seed bed, sowing the seed, fertilizing, spreading the vegetative type mulch, or spreading the wood cellulose fiber mulch in accordance with the applicable requirements of the following subsection entitled "Construction".

7. Top Soil: The Contractor shall make every reasonable effort to stockpile existing top soil prior to excavation and reuse it in the same general locations. No payment will be made for topsoil furnishing and placement necessary due to excessive hauling off of existing top soil on the project site.

8. Qualifications of Workman: Provide at least one person, who shall be present at all times during the execution of this work, who is thoroughly familiar with all materials and installation procedures included in the Sodding and Seeding operations as specified herein.

9. Delivery Containers: Deliver all items to the site in their original containers with all labels intact and legible at time of Owner inspection.

10. Protection: Use all means necessary to protect all materials before, during and after installation, and to protect the installed work and materials of all other trades.

11. Replacements: In the event of damage or rejection, immediately make all repairs and replacements to the approval of the Owner and at no additional cost to the Owner.

12. Weather Conditions: All sodding and seeding shall be performed during favorable weather conditions and only during normal and acceptable planting seasons when satisfactory growing conditions exist. The planting operations shall not be performed during times of extreme drought, when ground is frozen or during times of other unfavorable climatic conditions unless otherwise approved by Owner. The Contractor assumes full and complete responsibility for all such plantings and operations.

13. Planting Dates: Recommended dates for all seeding and planting shall be March 15 through October 15 unless otherwise approved by the Owner.

14. Pre-planting Inspection: Prior to the work of this section, the Contractor shall carefully inspect the installed work of all other trades and verify that all such work is complete to the point where installation may properly commence.

15. Discrepancies: Do not proceed with installation in areas of discrepancy until all such discrepancies have been fully resolved.

C. Construction: All equipment used in the project and all workmanship shall meet the approval of the engineer.

1. All areas to be seeded shall be tilled or disked to a depth of 3-4 inches and raked or smoothed to remove debris, clods, surface stone, 2-inches diameter or larger and weeds. Grades on the areas to be sodded or seeded shall be maintained in true, even and compacted conditions to prevent the formations of depressions. Areas overseeded, to be seeded that have washed or eroded shall be brought to grade and compacted thoroughly by the Contractor prior to placing the seeding or overseeding. No grading shall be done when the soils are in a muddy or frozen condition.

2. Steel Edging: The finish sub-grade of areas to be planted shall be 2" below top of steel edging, if present, for grass sod and flush with top of steel edging for seeding.

3. Other Edges: The finished sub-grade next to curbs, sidewalk and drive approaches shall allow for the seed to be placed level with the improvement. The sub-grade shall be finished level with the improvement for seeding.

4. Fertilizer Application: For areas to be seeded, fertilizer shall be applied when area receives final grading and tillage.

5. Application of Fertilizer. Before tilling the soil the fertilizer shall be distributed at a rate based on soil analysis or alternatively applied uniformly at the rate of 600 pounds per acre and incorporated into the soil to a depth of at least two inches (2") by discing or harrowing methods. Fertilizing rate is equivalent to seven (7) pounds per 500 square feet.

6. Acceptance of Plant Bed: Acceptance of the plant bed for seeding shall be obtained from the Owner for each section of area as indicated on the Plans. The Contractor shall be responsible for maintaining the accepted areas until the effective date for planting.

7. Sowing shall be accomplished by use of an approved mechanical seeder or drill (hand spreader can be used in small areas), making sure that successive seed strips overlap to provide uniform coverage. Seed should be drilled to a depth of 1/2 inch.

   a. Seed mixed in proportions shown in Section 8201.B. may be broadcast by approved sowing equipment. The seed shall be uniformly distributed over the designated areas. The seed shall be covered to an average depth of ½ inch by means of a brush harrow, spike-tooth harrow, chain harrow, cultipacker or other approved device.

b. Areas to be seeded shall be fertilized at rates specified in Section 8201.B.1. The seedbed shall be free of any irregularities in the surface, and shall be corrected in order to prevent formation of water pockets. All seeded areas are to be completely covered with hydro mulch or with straw anchored to the soil a minimum depth of 3 inches by a disc harrow set nearly straight, to properly maintain soil moisture and to provide shade for the newly germinated chutes.

c. Promptly after mulching, wet the seedbed thoroughly, keeping all areas moist throughout the germination period. Protect all turf areas by erecting temporary fences, barriers, signs, etc. as necessary to prevent trampling and disturbance.

d. When delays in operations carry the work beyond the most favorable planting season for the grasses designated, or when conditions are such, by reason of drought, high winds, excessive moisture, or other factors that satisfactory results are not likely to be obtained, the seeding operation shall be stopped and work shall be resumed only when conditions are favorable again or when approved alternative or corrective measures and procedures have been put into effect. If inspection during seeding operations or after indicate there are areas which have been skipped, the sowing of additional seed on these areas will be required.

e. The seeded areas will be inspected for acceptable grass coverage and will be acceptable when grasses designated are growing and are in good condition and no area more than ½ of one percent of the total areas shall be bare, of which no single area shall be more than one-foot square in area. Any bare area larger than this will not be acceptable and shall be reseeded.

8. Compaction: Immediately following the completion of seeding operations, the entire area shall be compacted by means of a roller weighing at least 60 but not more than 90 pounds per linear foot of roller.

9. Maintenance Period: The Contractor shall be responsible for maintaining the installed grass seed and sod until all areas are complete and accepted by the Owner.

10. Mulching: Mulching shall be done within 24 hours following the seeding operation except in the case of wood cellulose fiber type mulch.

11. Compaction. Immediately following the completion of seeding operation, the entire area shall be compacted by means of a roller weighing at least 60 but not more than 90 pounds per linear foot of roller.

12. Mulching. Mulching shall be done within 24 hours following the seeding operation except in the case of wood cellulose fiber type mulch.

a. Vegetative Type Mulch. After compacting the surface, mulch shall be uniformly spread at the rate of 1-1/2 tons per acre by means of a mechanical spreader or other approved means.

As soon as the mulch is spread it shall be anchored to the soil a minimum depth of three inches (3") by use of a heavy disc harrow, set nearly straight, or similar approved tool. Discs of the anchoring tool shall be set approximately 9 inches. Anchoring shall be accomplished by not more than two passes of the tool.

b Wood Cellulose Fiber Type. Wood cellulose fiber mulch shall be added to the hydraulic seeder after the proportionate amounts of seed, fertilizer and water, and other approved materials are added. These ingredients shall be mixed to form a slurry which shall be applied at the rate of 1,000 pounds per acre. The mulch shall make a uniform coverage of the soil surface that will be satisfactory to the Engineer.

## 8202 SODDING.

A. Scope. This section governs the furnishing of all labor, equipment, tools and materials, and the performance of all work for sodding in accordance with the Standard Drawings, the specifications and Special Provisions.

B Materials and Definitions.

1. Sod. Sod shall be a Tall Turf Type Fescue with 10 percent Bluegrass that is free of objectionable grassy and broadleaf weeds. Sod shall be considered free of such weeds if less than 5 such plants are present per 100 square feet of area. Sod will not be acceptable if it contains any of the following weeds: Common Bermuda grass, (wiregrass), quack grass, Johnson grass, poison ivy, nuts edge, mumble will, Canada thistle, bindweed, wild garlic, ground ivy, perennial sorrel and brome grass, or as defined by current weed laws.

a. Pad Size: The sod shall be cut to supplier's standard width and length but not less than 12 x 24 inches and not more than 24 x 72 inches or bigger sizes that are approved by the Owner. There shall not be broken pads, torn or uneven ends.

b. Strength: Root development shall be such that standard size pieces will support their own weight and retain their shape when suspended vertically from a firm grasp on the uppermost 10% of area.

c. Mowing Height: Before harvesting sod, it shall be mowed uniformly at a height of 2 - 2½ inches. The sod shall be stripped or harvested by machine at a uniform thickness of 1½ inches ± ¼ inch. Measurement of thickness shall exclude top growth and thatch.

2. Fertilizer. Fertilizer shall be inorganic 12-12-12 or 13-13-13 grade, uniform in composition, free flowing and suitable for application with approved equipment, delivered to the site in convenient containers, each fully labeled, conforming to applicable state fertilizer laws, bearing the name, trade name, or trademark and warranty of the producer.

3. Top Soil: The Contractor shall make every reasonable effort to stockpile existing top soil prior to excavation and reuse it in the same general locations. No payment will be made for topsoil furnishing and placement necessary due to excessive hauling off of existing top soil on the project site.

4. Qualifications of Workman: Provide at least one person, who shall be present at all times during the execution of this work, who is thoroughly familiar with all materials and installation procedures included in the Sodding and Seeding operations as specified herein.

5. Delivery Containers: Deliver all items to the site in their original containers with all labels intact and legible at time of Owner inspection.

6. Protection: Use all means necessary to protect all materials before, during and after installation, and to protect the installed work and materials of all other trades.

7. Replacements: In the event of damage or rejection, immediately make all repairs and replacements to the approval of the Owner and at no additional cost to the Owner.

8. Weather Conditions: All sodding and seeding shall be performed during favorable weather conditions and only during normal and acceptable planting seasons when satisfactory growing conditions exist. The planting operations shall not be performed during times of extreme drought, when ground is frozen or during times of other unfavorable climatic conditions unless otherwise approved by Owner. The Contractor assumes full and complete responsibility for all such plantings and operations.

9. Planting Dates: Recommended dates for all seeding and planting shall be March 15 through October 15 unless otherwise approved by the Owner.

10. Pre-planting Inspection: Prior to the work of this section, the Contractor shall carefully inspect the installed work of all other trades and verify that all such work is complete to the point where installation may properly commence.

11. Discrepancies: Do not proceed with installation in areas of discrepancy until all such discrepancies have been fully resolved.

C. Construction Details.

1. Sod shall not be harvested or delivered when excessively wet or dry. Sod shall be harvested, delivered and installed within a period of 36 hours. Protect sod from sun, wind, dehydration, and rain prior to installation that cannot be placed immediately on delivery. Sod showing visible signs of heating or dehydration will be rejected.

2. Areas to be sodded shall be fertilized at the rates specified in Section 8201.C. The sod-bed shall be free of any irregularities in the surface resulting from fertilizing or other operations and shall be corrected in order to prevent the formation of water pockets. Freshly graded areas, which have set long enough to become dry and crusted over, shall be tilled as specified above, prior to placing the sod.

3. The first row of sod should, if possible, be laid in a straight line with subsequent rows placed parallel and tightly against one another. Lateral joints shall be staggered as in brick laying to promote more uniform growth and strength. Care shall be exercised to ensure that the sod in not stretched or overlapped and that all joints are butted tight in order to prevent voids which would otherwise cause air drying of the roots. Where new sod meets existing grassed areas, a straight, vertical edge shall be cut to allow smooth match. Sod shall be watered and firmed in accordance with Section 8202.C. If it is necessary to walk excessively on newly laid sod or soil, walking boards should be laid for this purpose.

4. Sod shall be laid with staggered joints and at right angles to direction of slope. Sod shall be secured by tamping or rolling. On slopes 4:1 or steeper and in drainage channels, all sod shall be anchored at minimum two-foot intervals to prevent movement under rainfall conditions.

5. The Contractor shall be responsible for having adequate water available at the site prior to and during the installation of the sod and the areas to be seeded. The sod shall be watered immediately after installation to prevent drying during progress of the work. As sodding is completed on any one section, the entire area shall be thoroughly irrigated to a one-inch depth below the new sod pad. After a short drying period, the sod shall be rolled with a roller weighing not less than 60 or more than 90 pounds per linear foot to firm the sod pad and smooth minor surface irregularities. Subsequent watering should maintain sod and soil moisture to a depth of at least four inches, supplement rainfall, to promote growth, promote proper rooting to insure sod survival, and to prevent dormancy.

6. Apply second application of fertilizer at the rate of 300 pounds per acre two weeks after laying sod and prior to final acceptance.

7. The sodded areas will be inspected for the acceptable grass coverage and will be acceptable when grasses designated are growing and are in good conditions, and no area more than ½ of one percent of the total area shall be bare or dead, of which no single area shall be more than one-foot square in area. Any bare or dead area larger than this will not be acceptable, and shall be resodded.

8. Maintenance Period – The Contractor shall be responsible for maintaining the installed grass seed and sod until all areas are complete and accepted by the Owner.

9. Maintenance of sodded areas shall include watering, weeding, mowing to a 2½ inch height after growth has exceeded 3 inches and prior to a 4-inch growth, replacement and installation of sod as originally specified for sodded areas failing to survive, and repair of rutting, should that occur. Clippings from mowing which mat on the grass are to be removed.

8203 GUARANTEE. The contractor shall guarantee all work and materials for a period of one year after the date of final acceptance of the project. During the guarantee period, all turf which dies shall be replaced, all bare spots shall be reseeded by and at the expense of the contractor, with like material.

# SECTION 9000 MATERIALS TESTING

9001 SCOPE. This section shall apply to all required testing services for soils, asphalt and concrete.

9002 GENERAL. All materials testing shall be conducted by a testing laboratory qualified and approved by the City to perform the required sampling, analysis, testing and report writing services. Reports shall be prepared by or under the supervision of and bear the seal and signature of a professional engineer licensed in the State of Missouri. Improperly completed or certified reports will not be accepted.

9003 RESPONSIBILITIES OF THE CONTRACTOR OR DEVELOPER. When required by the Engineer, the contractor or developer shall provide all the required tests as herein specified at his expense. The contractor shall allow the testing agency access to the job site as may be required and shall furnish any labor as may be required by the testing agency to obtain and handle samples at the source of the material and at the site of the work. Adequate facilities shall be provided at the project site for the safe storage and proper curing of specimens requiring such facilities. The use of a testing agency's service does not relieve the contractor of the responsibility to furnish the required materials and to perform the required construction in full compliance with the City of Branson Technical Specifications. The successful passing of a test does not constitute acceptance of the work or materials represented by the test or any portion of the work or materials. Final acceptance of the project shall be granted only through the issuance of a Project Completion Certificate by the City of Branson and the expiration of the two (2) year maintenance period as established in these specifications.

9004 RESPONSIBILITIES OF THE TESTING AGENCY. All testing agencies shall meet the requirements of ASTM E329. A representative shall inspect, sample and test the materials and work as required by the director of public works/engineering. Any material furnished or work performed by the contractor failing to conform to the specification requirements shall be immediately brought to the attention of the director of public works/engineering and the contractor. Preliminary written field reports of all tests and inspection results shall be given to the contractor immediately after they are performed. A copy of all reports shall be forwarded to the director of public works/engineering as they are made available. Results of all tests taken, including failing tests, shall be reported. The testing agency and its representative are not authorized to revoke, alter, relax, enlarge or release any requirement of the specifications, nor to approve or accept any portion of the work.

9005 ASPHALT TESTING. Sampling and testing of the asphalt mix shall be required on all asphalt paving projects constructed in the City of Branson.

Samples of the actual asphalt mix being used on a paving project shall be acquired by a qualified testing laboratory technician at either the construction site or the batching plant in accordance with ASTM Standards D979 and D3665. These samples shall be used to perform an aggregate gradation test (ASTM C136), asphalt extraction test (ASTM D2172), stability and flow test (ASTM D1559) and bulk specific gravity test (ASTM D2726). One complete group of tests shall be conducted on both the base material and the surface material for each paving project.

In-place density tests shall be conducted with a nuclear testing device during the course of the work. Density tests may be performed by City inspectors to verify that the performance specifications in Section 1409(E) (Density and Surface Requirements) of this specifications manual have been achieved. The number of tests to be taken and the locations thereof shall be determined by the inspector based upon his observation of the paving process. A minimum of two (2) tests per 1,500 feet of street improvement shall be taken unless otherwise directed by the director of public works/engineering. Tests performed with a nuclear device shall be conducted in accordance with the requirements of ASTM D2950.

9006 CONCRETE TESTING. Sampling and testing shall be required on all concrete work including curb and gutter, sidewalk, slope paving, retaining walls, inlets, manholes or any other structures as directed by the Engineer.

During the progress of the work, compression tests of the concrete used shall be made as directed by the engineer in accordance with the requirements of ASTM C31, C143, and C172. At least one sample, consisting of four (4) cylinders minimum, shall be taken from each 100 cubic yards of concrete placed or fraction thereof. In the event that the total amount of concrete on a project does not exceed 200 cubic yards, a minimum of four (4) specimens (consisting of four (4) cylinders each) shall be submitted for the project. In the case of a reinforced concrete box, a minimum of one sample shall be taken for each days pour. The cylinders shall be cast in the field and transported to the laboratory 24 hours after the concrete was placed. Each set of compression test cylinders shall be marked and tagged with the date and time of day the cylinders were made, the location in the work where the concrete represented by the cylinders taken was placed, the delivery truck or batch number, the air content, and the slump. From each sample consisting of four cylinders, one (1) shall be broken at seven (7) days, one (1) at 14 days and two (2) at t28 days noting the compressive strength of each break.

Slump tests (ASTM C143) and air tests (ASTM C231) shall be made for each 25 cubic yards of concrete placed or fraction thereof. A minimum of two (2) slump and air tests shall be taken per day. Slump and air tests shall be taken with each cylinder series.

If samples of fresh concrete have not been obtained and tested, a minimum of three (3) cores shall be taken per ASTM C42 and broken as directed by the Engineer. Air content (ASTM D457) and cement content (ASTM C85) shall also be determined. Concrete in the portion of the structure from which the core was taken will be considered adequate if the average strength of the cores is equal to a minimum of 95% of the specified strength (f'c) and if the strength of any single core is not less than 80% of f'c. All core holes shall be completely filled with a low-slump, high strength concrete at the expense of the contractor.

All reports by testing laboratories shall include the type of structure and information on obtaining, transporting, storing, curing, time between obtaining and casting cylinders (when applicable), supplier, finisher and batch as well as the specific test data.

9007 SOIL TESTING. Sampling and testing shall be required on all subgrade preparation for street construction and all trench backfilling operations within the City of Branson. Prior to the contractor commencing subgrade compaction for any street improvement project, the director of

public works/engineering shall designate the locations and depths at which a qualified technician shall acquire samples of soil for performing a moisture density test (ASTM D698 for cohesive soils and ASTM D2049 for non-cohesive soils). A minimum of one (1) density test and maximum of two (2) density tests shall be performed for every 1,000 feet of street construction.

Reports for moisture-density tests shall include the date, the location of the tests, the elevation or depth at which the test was taken, the maximum dry density, and the optimum moisture content as well as properly constructed moisture density curves for each sample. Also included shall be a determination of the soils plastic index (PI) and classification in accordance with ASTM D2487.

During the progress of the subgrade preparation, in-place density tests shall be performed with a nuclear density tester by a qualified technician approved by the City of Branson. The number of tests to be taken and the location thereof shall be determined by the inspector based upon his observation of the subgrade preparation. A minimum of two (2) tests per lift per 1,500 feet of street improvement shall be taken unless otherwise directed by the director of public works/engineering. Results of these tests shall indicate whether or not the performance specifications stated in Section 1205 (Compaction Requirements) of this specification manual have been achieved. If the tests indicate the compaction is not sufficient, the contractor shall increase the compactive effort on all such inadequately compacted areas. Tests performed with a nuclear device shall be conducted in accordance with the requirements of ASTM D2922.

During the progress of the work of trench backfilling, in-place density tests shall be performed with a nuclear density tester by a City of Branson inspector or qualified laboratory technician. The number of tests to be taken and the locations thereof shall be determined by the inspector based upon his observation of the backfilling process. A minimum of two (2) tests per 1,000 feet of trench shall be taken unless otherwise directed by the director of public works/engineering. Results of these tests shall indicate whether or not the performance specifications stated in this specification manual have been achieved. If the tests indicate the compaction is not sufficient, the contractor shall increase the compactive effort on all such inadequately compacted areas.