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Design Standards
Section 8
Pipeline Construction

SECTION VIII
PIPELINE CONSTRUCTION

8-1 GENERAL

This section covers the requirements for trenching and backfilling for underground pipelines. Backfill shall include filling of all trenches to the original ground surface or final grading elevations as shown on the drawings or otherwise directed by the Engineer.

8-2 CONTROL OF GROUND WATER

All trenches shall be kept free from water during excavation, fine grading, pipe laying, jointing, and embedment operations. Where the trench bottom is mucky or otherwise unstable because of the presence of ground water, and in cases where the static ground water elevation is above the bottom of any trench or bell hole excavation, such ground water shall be lowered to the extent necessary to keep the trench free from water while the trench is in progress. Surface water shall be prevented from entering trenches.

8-3 EXCAVATION FOR PIPELINES

Trench excavation shall include all operations necessary for excavation of all materials of whatever nature coming within the designated lines of the trenches. Trenches shall be made to the lines shown on the drawings or otherwise established by the Engineer, and to a depth as to provide a minimum burial of three feet over the pipe unless otherwise specified. The bottom two feet of the trench shall be vertical. All finish grade excavation necessary for preparation of the trench bottom shall be made manually. No over-excavating shall be allowed without re-compaction of backfill in accordance with these specifications. Excavation for trenches in ledge rock, cobble rock, stones, mud or other material unsatisfactory for pipe foundation shall extend to a depth of at least four inches below the bottom of the pipe. A bedding of special material shall be placed and thoroughly compacted with pneumatic tampers in four inch lifts to provide a smooth, stable foundation. Special foundation material shall consist of suitable earth materials free from roots, sod or vegetable matter. Trench bottoms shall be hand shaped as specified in the paragraph above. Where unstable earth or muck is encountered in the excavation at the grade of the pipe, a minimum of twelve inches below grade will be removed and backfilled with crushed rock or gravel to provide a stable sub-grade.

The maximum width of the trench, measured at an elevation equal to the top of the pipe, shall be as narrow as possible but not wider than fifteen inches on each side of sewer and water pipe.

3.1 GRAVEL FOUNDATION FOR PIPE. Wherever the subgrade material does not afford a sufficiently solid foundation to support the pipe and Superimposed load, where water must be drained to maintain a dry bottom for pipe installation and at other locations as previously defined, the subgrade shall be excavated to the specified depth and replaced with crushed rock or gravel. Gravel for pipe foundations shall be clean, crushed rock or gravel conforming to the following gradation:

| <u>Screen</u> | <u>Percent Passing</u> |
|---------------|------------------------|
| 1/4 | 100 |
| No.50 | 5 |

The gravel material shall be deposited over the entire trench width in six inch

maximum layers. Each layer shall be consolidated by tamping, rolling, vibrating, spading, slicing, rodding or by a combination of one or more of these methods. In addition the material shall be graded to produce a uniform and continuous support for the installed pipe.

8-3.2 BLASTING. Blasting will not be allowed except by permission from the Engineer. The Contractor shall comply with all laws, ordinances, and applicable safety code requirements and regulations relative to the handling, storage, and use of explosives and protection of life and property. He shall be fully responsible for all damage attributable to his blasting operations. Excessive blasting or overshooting will not be permitted and any material outside the authorized cross-section which may be shattered or loosened by blasting shall be removed by the Contractor.

8-3.3 SHEETING, BRACING, AND SHORING OF EXCAVATIONS. Excavations shall be sheeted, braced, and shored as required to support the walls of the excavations, to eliminate sliding and settling, and as may be required to protect the workmen, the work in progress and existing utilities and improvements. All such sheeting, bracing, and shoring shall comply with the requirement of the Utah State Industrial Commission. All damage resulting from lack of adequate sheeting, bracing and shoring shall be the responsibility of the contractor, and the contractor shall affect all necessary repairs or reconstruction resulting from such damage.

8-4 PIPE LAYING AND BEDDING

Pipe will be carefully inspected in the field before and after laying. If any cause for rejection is discovered in a pipe after it has been laid, it shall be removed and replaced by the Contractor at his expense.

When connections are to be made to any existing pipe, conduit or other appurtenances, the actual elevation or position of which cannot be determined without excavation, the Contractor shall excavate for, and expose the existing improvement before laying any pipe or conduit. The Engineer shall be given the opportunity to inspect the existing pipe or conduit before connection is made. Any adjustments in line or grade which may be necessary to accomplish the intent of the plan will be made.

Pipe shall be laid upgrade with the socket or collar ends of the pipe upgrade unless otherwise authorized by the Engineer.

Pipe shall be laid true to line and grade, with uniform bearing under the full length of the barrel of the pipe. Suitable excavation shall be made to receive the bell or collar, which shall not bear upon the sub-grade. Any pipe which is not true to alignment or shows any settlement after laying shall be taken up and relaid at the Contractor's expense.

8-4.1 REQUIREMENTS FOR LINE AND GRADE. All sewer pipe shall be installed accurately to the defined line and grade within the following limits: variance from established line and grade shall not be greater than 1/32 of an inch per inch of pipe diameter and not to exceed 1/2 inch, provided that such variation does not result in a level or reverse sloping invert; provided also that variation in the invert elevation between adjoining ends of pipe, due to non-concentricity of joining surface and pipe interior surfaces does not exceed 1/64 inch per inch pipe diameter, or 1/2 inch maximum.

Wherever possible, sanitary sewer shall be installed on the downhill side of the street.

8-4.2 INSTALLATION OF PIPE. A groove shall be excavated in the bottom of the trench to receive the bottom quadrant of the pipe. Before preparing the groove, the trench bottom shall be excavated or filled and compacted to an elevation sufficiently above the grade of the pipe so that, when completed, the pipe will be true to line and grade. Bell holes shall be excavated so that only the barrel of the pipe receives bearing from the trench bottom. Large rocks (over six inches) near the surface shall be removed and the hole refilled with approved backfill.

Sewer and drain pipe shall be laid upgrade. All pipe installation shall proceed with joints closely and accurately fitted. Gaskets shall be fitted properly in place and care shall be taken in joining the pipe units to avoid twisting of gaskets. Joints shall be clean

and dry and a joint lubricant, as recommended by the pipe supplier, shall be applied uniformly to the mating joint surfaces to facilitate easy, positive joint closures.

If adjustments or position of a pipe length is required after being laid, it shall be removed and re-jointed as for a new pipe. When laying is not in progress, the ends of the pipe shall be closed with a tight-fitting stopper to prevent the entrance of foreign material. In addition to the above requirements, all pipe installation shall comply to the specified requirements of the pipe manufacturer.

8-4.3 PIPE BEDDING. In these specifications, the process of preparing the trench bottom to receive the pipe and the backfilling on each side of the pipe to a level over the top of the pipe is defined as bedding. Pipe shall be protected from lateral displacement and possible damage resulting from impact or unbalanced loading during backfilling operations by being adequately bedded.

Pipe bedding materials placed at any point below an elevation twelve inches above the top of the pipe shall be deposited and compacted in layers not to exceed six inches in compacted depth. Deposition and compaction of bedding materials shall be done simultaneously and uniformly on both sides of the pipe. Compaction shall be accomplished with hand or mechanical compactors. All bedding materials shall be placed in the trench with hand tools or other approved method in such a manner that they will be scattered alongside the pipe and not dropped into the trench in compact masses. Bedding materials shall be loose earth, free from lumps, sand or gravel, from rocks larger than 1 1/4 inch diameter, with all materials free from roots, sod, or other vegetable matter.

8-5 BACKFILLING

Backfill shall be carefully placed around and over pipes and shall not be permitted to fall directly on a pipe from such a height, or in such manner as to cause damage. Bedding requirements are as defined in Section 8-4 of these specifications.

The backfill in all utility trenches shall be either compacted or consolidated according to the requirements of the materials being placed. Under pavements Or other surface improvements, the in-place density shall be a minimum of 95 percent of laboratory standard maximum dry density as determined by AASHTO 1-180. In shoulders and other areas, the in-place density shall be a minimum of 90 percent of the maximum dry density as determined by the same test.

8-5.1 MATERIAL. Backfill material shall be approved by the Engineer and shall not contain any wood, grass, roots, broken concrete, trash, or debris of any kind that may cause unequal settlement or improper consolidation. No gravel larger than 1 1/2 inches shall be used at the pipe zone.

8-5.2 BACKFILL PROCEDURE AT PIPE ZONE. Backfill of selected material shall be placed carefully in six inch horizontal layers and tamped to a depth of one foot over the top of the pipe except that joints, couplings, fittings, and valves shall be left uncovered until after the pipe has been tested. Backfill of selected material shall then be placed carefully and thoroughly tamped around the joint, couplings, fittings, and valves to a depth of one foot above the pipe, after which the remainder of the trench shall be backfilled.

8-5.3 BACKFILL PROCEDURE ABOVE PIPE ZONE. The backfill above a point one foot above the top of the pipe shall be backfilled in horizontal layers twelve inches thick or less with materials containing no brush, perishable or objectionable material, rocks, stones, or boulders larger than eight inches in the greatest dimension. The material shall be consolidated thoroughly by puddling with hose and long pipe nozzle or by flooding the trench, or compacted by mechanical tamping of the opinion of the Engineer the material does not consolidate readily by puddling or flooding. Wherever in the opinion of the Engineer surface settlement is not important consolidation or compaction may be omitted and the backfill shall be neatly rounded over the trench to a sufficient height to allow for settlement to grade after consolidation.

8-5.4 COMPACTION OF BACKFILL. Consolidation of sandy material shall be accomplished by saturating the material and rodding it by hand with a hose, pole, or rod, or by driving rubber-tired or tracked equipment over it while saturated. The backfill

may be thoroughly consolidated by flooding with water by one of the following methods:

The water shall be allowed to flow slowly into the trench from the upper end, and shall be worked down to the bottom of the trench by "poling." Poling is accomplished by forcing a pole down through the backfill to a level of the pipe and moving it around to let the water flow down the hole. The channel made by the pole shall be kept open until the water running in has settled the backfill.

Where there are tunnels, the poles shall be inserted into the upper end and the water allowed flow through the tunnel, carrying fill material with it, until the tunnel is completely filled. The poles shall then be inserted in the lower side and the settled portion shall be filled with dirt.

After the water-settled trench has set for several days, any depression in the trench shall be filled, mounded over and wheel rolled to compact the material thus placed.

All precautions necessary shall be taken by the Contractor to prevent damage and movements (including floating) of the pipeline structures and existing adjacent improvement and utilities. The allowance of the use of consolidation methods shall not be construed as guaranteeing or implying that the use of such methods will not result in damage to adjacent ground. The Contractor shall make his own determination in this regard, and shall assume all risks and liability for settlement, or utilities, either on the surface of the ground or underground.

For trenches under ten feet, the backfill may be flooded in one lift. For depths greater than ten feet the backfill shall be flooded in lifts of ten feet or less, unless otherwise permitted by the Engineer.

Where the trench has a grade steep enough to prevent the water from ponding and settling into the backfill, the Contractor shall place dams across the trench to force the water to stay in each small area long enough to thoroughly inundate the material to obtain the maximum settlement.

Where shown on the drawings and where directed by the Engineer, structural and trench backfill shall be deposited in horizontal layers and compacted by the following method in such a manner that the compacted material will be homogenous and free from lenses, pockets, streaks, and other imperfections.

The materials shall be deposited in horizontal layers across the length or width of the excavation not more than six inches thick after being compacted. The excavation and placing operations shall be such that the materials when compacted will be blended sufficiently to secure the best practicable degree of compaction, impermeability, and stability. Prior to and during compaction operations, material shall have the optimum moisture content and shall be uniform throughout each layer. Insofar the materials shall be prepared at the site of excavation. If the moisture content is not optimum for compaction, the compaction operations shall be delayed until such time as the material has been brought to the optimum moisture content. When the material has been properly conditioned, it shall be compacted in embankments using tamping rollers.

Pneumatic rollers, when used in lieu of tamping rollers, shall consist of pneumatic tires arranged in a manner so as to provide a satisfactory compacting unit. The roller shall have an effective rolling width of at least sixty inches and shall give the compression of at least 275 pounds per inch of width of tread when fully loaded. The tires shall be uniformly inflated. The roller and the operating power unit shall meet the approval of the Engineer.

When hand compacted methods are specified or required because of the location of the area to be compacted, pneumatic tampers or other approved hand compacting equipment shall be used.

The dry density of the soil fraction in the compacted material shall be not less than 90 percent, unless structures are to be placed on the fill; then it shall be not less than 95 percent of the laboratory standard maximum soil density (dry) as determined by compaction tests made in conformity with the latest revision of ASTM Designation D-698.

8-6 TRENCHES ON HIGHWAYS AND STREETS

Wherever trenches must cross state highways or major county or city streets, the Contractor shall obtain such excavation permits as are required for these crossings and shall become familiar with and abide by the rules and directions of these public agencies while constructing lines in streets or backfill with sand as they may direct.

The Contractor shall replace the asphalt or concrete surfacing removed in the trenching operations with a surfacing that is equal to the previous surfacing, and in addition will meet the approval of the State or County or City having jurisdiction.

The Contractor shall continue to maintain the street, patch level with the surrounding roadway surfaced for smooth travel.

Surplus material shall be gathered up and disposed of by the contractor as directed by the Engineer.

8-6.1 ALLOWABLE LENGTH OF OPEN TRENCH. Unless otherwise approved by the Engineer, not more than 500 feet of trench shall be left unfilled in the rear thereof.

The elapsed time from the beginning of excavation at any point in a public street until completion of backfill and temporary resurfacing at such point shall not in any case exceed a period of five calendar days. All streets and roads used shall be kept free from dust and open to through traffic unless permission to close certain streets or roads is obtained by the Contractor from the authorities concerned. Up to 1/2 the width of each street or road shall be temporarily resurfaced for use before excavation is started on the remaining portion of the street or road. Where required by authorities having jurisdiction over street and highways, satisfactory detours shall be provided by the Contractor at his expense.

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