TECHNICAL NOTES

U.S. DEPARTMENT OF AGRICULTURE NATURAL RESOURCES CONSERVATION SERVICE

ENGINEERING # 8 **SPOKANE, WASHINGTON**

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IRRIGATION PIPE COVER REQUIREMENTS

BACKGROUND

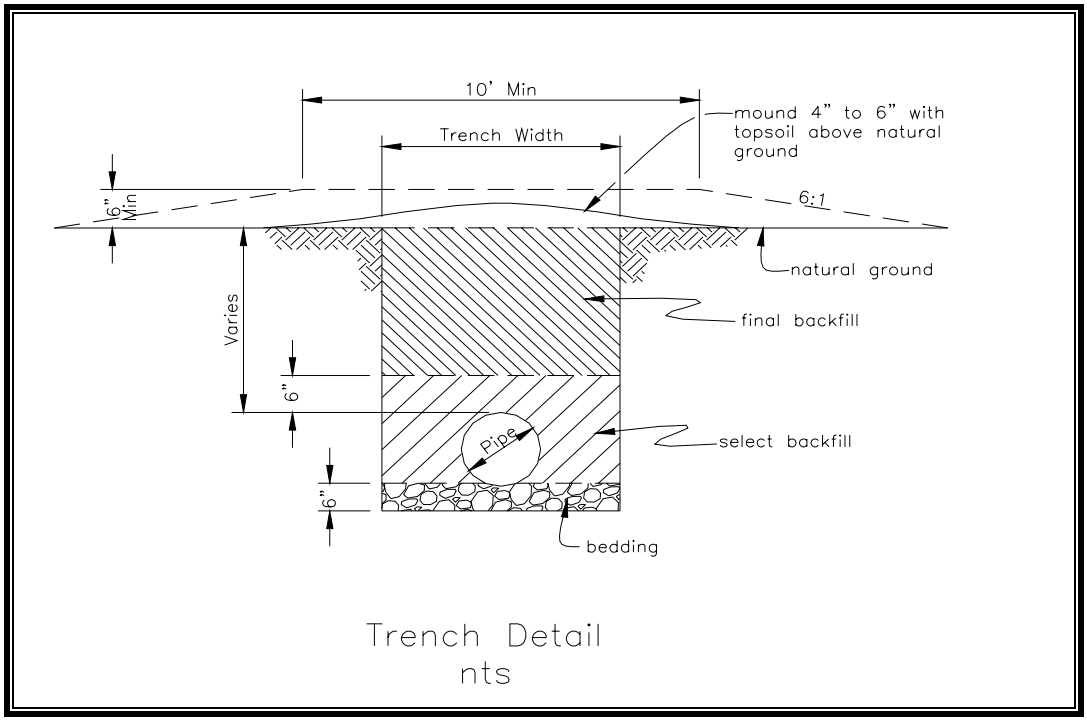
Since cover depths are no longer listed in the NRCS practice standards, the issue of pipe cover on irrigation systems needs addressing. This technical note includes various types of pipe that we use and the techniques, or references, to calculate loading on pipe. Research included a number of different manufactures, suppliers, reference manuals, and standards.

SUMMARY

The amount of soil cover over pipeline installations varies depending on these factors: location of the line, climate, soils, bedding, trench, and pipe type. The minimum cover amount should be adequate for locations where the pipe will 1) not have disturbance due to traffic or farming, and 2) can drain when not in use. Entrances to the field or areas of normal farm activity increase the loading on the pipe and therefore the chance for crushing. These areas require the pipe to have more protection. Protection could be increased by providing more cover, heavier pipe, better backfill installation, or by placing the pipeline inside a stronger pipe. Where the line will not be drained, protection against freezing should be considered during the design. In order to keep costs down, trenching is generally done to the least depth necessary to protect the pipe.

Maximum cover amounts are dependent on: pipe type, bedding shape, compaction during installation, and depth of fill. The maximum cover depths need to be calculated for each site and class of pipe. Designs need to include loadings and maximum cover depths where the pipe is located in areas with high loads. This is further explained with each of the different pipe types and in the references, listed in the footnotes.

Both trench width and backfill compaction requirements are necessary in order to determine the loading that the pipe will have to withstand and to ensure the pipe will perform as designed. The following trenching detail drawing is provided to define terms used in this note.



Trench Detail
nts

TERMS DEFINED

- **Bedding** – that portion of the trench and/or backfill that is prepared or in place before installing the pipe. Where soils and drainage characteristics permit, the trench bottom may serve as the bedding. The material should be a fine texture (less than 1" rounded rock) and compacted to a minimum of 85% of Standard Proctor[1]. The 85% Standard Proctor compaction would be equivalent to existing surrounding soil amounts.

- **Select Backfill** – that portion of the trench from the invert of the pipe to 6" above the top of the pipe. This zone can be further defined as below the center of the pipe (haunch zone) and above the center line of the pipe (initial backfill). The bedding and the select backfill zone provide a significant role in the structural performance of the installation. The actual compaction of this material affects the loads the pipe will hold. Material size is also important to eliminate the possibility of a point load on the pipe from a cobble or boulder. Generally material size is limited to a 1" rounded rock, with finer texture soil being better.

- **Final Backfill** – that portion from the top of the initial backfill to the top of the trench. Specific compaction requirements are necessary only where loading or settling limits are a part of the design. Material size should be less than 3" and well graded. Mounding can be used to provide cover and material for settling.

- **Trench Width –** in shallow buried applications with flexible materials, like plastic, the trench width is critical to transfer the load over the pipe to the side of the haunch zone of the pipe. Where compaction is required the minimum width should be 12" on each side of the pipe. The trench should be large enough to accommodate compaction equipment, where necessary, to prevent damage to the pipe. Sites where compaction is not needed to support the pipe the maximum

trench width in the haunch zone is 12". Ditches dug with trenchers provide adequate bedding support and are generally used in areas with fine texture soils that can provide the necessary support for the pipe, to the depths installed.

SPECIFIC PIPE DETAILS

NRCS Practice 430 AA

Aluminum Tubing

Not generally recommended to bury due to cost, soil, and pipe corrosion potential. When used as a supply line, could be buried but installation would need to be monitored and controlled to ensure loading and damage to coatings does not occur. Material costs and availability limit the amount of buried aluminum pipe installed.

NRCS Practice 430 CC

Non-Reinforced Concrete Pipe [2]

The minimum cover for concrete pipe is 12". Concrete pipe requires good bedding preparation and backfill control to provide support in the haunch area of the concrete pipe. There are numerous references available for concrete pipe, which should be used when using this pipe. See the reference list at the end of the document for more information.

NRCS Practice 430 DD

High Pressure Plastic Pipe[3, 4]

The minimum cover for high pressure plastic pipe is 1 ft. For sites where farming occurs, 30 inches of cover is a minimum. The 30" of cover is deep enough to prevent disturbance from field work but not too deep to cause problems with crushing. At the 30" depth the possibility of freezing is eliminated for most sites in Washington. Where the pipe is buried closer to the surface, the line should be drained to protect from freezing.

The maximum amount of cover is based on the bedding and select backfill material, compaction in the haunch areas, bedding support and class of pipe. There are a number of sources available for calculating loading on plastic pipe, including some listed at the end of this document.

The maximum depth of cover for high pressure pipe (80 psi and above) with fine texture soils and minimal compaction is around 5 ft. See the references for information on how to check for loadings on plastic pipe and how to calculate the maximum depth of cover.

For above ground installations of plastic pipe the material must be ultraviolet(UV) protected. That requires coating the entire exterior surface of the pipe with 2 coats of acrylic latex paint. Thermal expansion and contraction must be checked in the design, plus pipe supports need to be included in the design for above ground installation of plastic pipe. At sites where fire is a potential hazard, above ground installations will not be allowed.

NRCS Practice 430 EE

Low Pressure Plastic Pipe

For Polyvinylchloride (PVC) and Polyethylene (PE) pipe the information from the high pressure pipe section would apply to the low pressure pipe. The 1 ft minimum cover and the 30" standard depth of cover would apply.

Maximum depth of cover with low pressure plastic pipe needs to be looked at any time the material is subjected to trench depths greater than 4 ft. This material has a very thin wall thickness so the trench bottom and haunch zones must be compacted to support the pipe and backfill loads.

A new type pipe that is now allowed under this practice standard is biwall pipe. This is pipe that has corrugations on the outside and smooth on the inside. There are different classes of internal pressure for different manufactures for this pipe, but the difference is generally in the joints, while the pipe remains the same. For biwall pipe, the minimum cover is 1 ft. The maximum depth of cover depends on the pipe size, compaction, and class of trench. See specific charts for the pipe type from the supplier for backfill class, trench requirements, and compaction level. A typical manufacturer is listed in the references.[5]

NRCS Practice 430 FF

Steel Pipeline [6]

Steel pipe can be used above ground or buried. There are different thicknesses of steel and various material coatings. For underground installations, the corrosion protection necessary is provided in the practice standard. Minimum cover on steel pipe is 2 ft. In areas where 2 ft is not available, mounding, surface barriers, or extra heavy gage pipe are alternatives. Bedding used to protect the pipe and backfill needs to be installed according to future use in the area. If settling is not an issue at the location of the pipeline, minimal compaction would be required in the trench.

NRCS Practice 430 HH

Rigid Gated Pipeline

Gated pipe is generally used above ground. Pipe type is either plastic or aluminum. The plastic material is UV protected for above ground installation. The pipe can be buried at access sites but the extent should be limited as this pipe requires good backfill control to eliminate the possibility of squashing or crushing the thin walls. Placing this pipe inside another pipe is a feasible alternative for installation where burying is required. This will reduce the potential for overloading and also protect the pipe.

Pipe Cover - Summary Table

	Minimum Depth of Cover		Maximum Depth of Cover		Above Ground[7]	
	Undisturbed Locations	Farm Field and Road Crossings	Without Documentation	Farm Field and Road Crossings	**Required**	**Allowed**
430 AA *Aluminum Tubing*	**n/a**	**n/a**	**n/a**	**n/a**	**X**	**n/a**
430 CC *Non-Reinforced Concrete Pipe*	**12”**	**30” or Compute loadings**	**n/a**	**Compute w/ Supplier Data**	**n/a**	**X**
430 DD *High Pressure Plastic Pipe*	**12”**	**30”**	**60”**	**Compute w/ TR77**	**n/a**	**X**
430 EE *Low Pressure Plastic Pipe*	**12”**	**30”**	**48”**	**Compute w/ TR77**	**n/a**	**X**
430 FF *Steel Pipeline*	**24”**	**24”**	**Compute or Supplier Data**	**Compute or Supplier Data**	**n/a**	**X**
430 HH *Rigid Gated Pipeline*	**n/a**	**n/a**	**n/a**	**n/a**	**X**	**n/a**

[1] Standard Proctor is described in American Standard of Testing Material D698-00a - *Standard Test Method of Laboratory Compaction Characteristics of Soil Using Standard Effort*.
[2] American Concrete Pipe Association, Concrete Pipe Design Manual, Reprinted in 2004; information is available at: http://www.concrete-pipe.org/manual/START.pdf
[3] AWWA C900, PVC Pressure Pipe, 4 in. through 12 in. for Water Distribution, 1989
[4] TR 77 Design and Installation of Flexible conduits, Plastic Pipe, USDA-NRCS, Aug 1990
[5] Hancor Pipe, reference information is available at – http://www.hancor.com/daids/dh60_index.asp
[6] Steel Pipe-A Guide for Design and Installation, AWWA M11, 1989
[7] Above ground installations require complete analysis of loads, forces, thermal expansion and contraction, and thrust restrains to ensure stability of the pipe.