

Sand as Insulation

201210C-AQTTB; Date Issued: 24 October 2012

ASHRAE 90.1-2022², Table 6.8.3A “Minimum Pipe Insulation Thickness Heating and Hot Water Systems” lists the required insulation conductivity for piping carrying hot water heating and domestic hot water systems. Some of the data from that table have been summarized below:

Fluid Temp. (F°)	Conductivity	Pipe or Tube Size				
		<1	1 to < 1 ½	1 ½ to < 4	4 to < 8	>_ 8
141°F – 200°F	0.25 – 0.29	1.5	1.5	2.0	2.0	2.0
105°F – 140°F	0.22 – 0.28	1.0	1.0	1.5	1.5	1.5

For example, a 1-1/2” pipe carrying 140oF domestic hot water would need to have an insulation with a K-Value of 0.22 – 0.28 with a minimum thickness of 1 1/2”.

For pipe buried underground the code allows a reduction in the amount of insulation by 1.5-in, but not to thicknesses less than 1-in.

Anyone who has walked on a hot, sunny beach knows that sand is a good insulator. Dry coarse-grained sand may be used as a substitute for the insulation required by code in a buried pipe situation. The sand should have a maximum particle size of 1/4” and a moisture content of 1% or less. The thermal conductivity, K, of coarse, dry sand varies between 0.15 – 0.25 W/mK. Converting to Imperial units = 1.7 Btu.in/ft2.oF.hr. R-value is the reciprocal of conductivity, therefore, the R-value of coarse dry sand = 0.58 ft2.oF.hr/Btu.in.

1-inch of fiberglass insulation with a conductivity of 0.27 has an R-value of 3.70. Conversely, 6” of dry coarse sand has an R-value of 3.46; 12” would have an R-value of 6.92.

In addition, some provisions need to be made to keep the insulating sand as dry as possible. Saturated sand has a thermal conductivity in the range of 2-4 W/m-K which causes the required sand layer thickness to be significantly higher.

In areas where it is anticipated that the sand may become wet, provide a layer of 4-6 mil impermeable liner in the trench first, under the sand to wrap/enclose the sand after the pipe is laid. The idea is to wrap the pipe and the sand as insulation in the liner.

1. Ensure the trench is free from any objects/materials that may damage the liner
2. Lay the liner in the pipe trench
3. Install the first layer of sand
4. Install the pipe
5. Install the remaining sand

6. Wrap the impermeable liner up the sides and over the top of the sand overlapping itself by at least 12". Successive sections of liner should overlap the previous sections by at least 12".
7. Install a second layer of liner over the top of the pipe and sand to cover the overlap
8. Backfill as specified being careful to ensure that the liner material will not be damaged.

Thus, it can be shown that sand may be a good replacement for fiberglass pipe insulation in underground, direct buried applications. It's easier to install and will typically cost less.

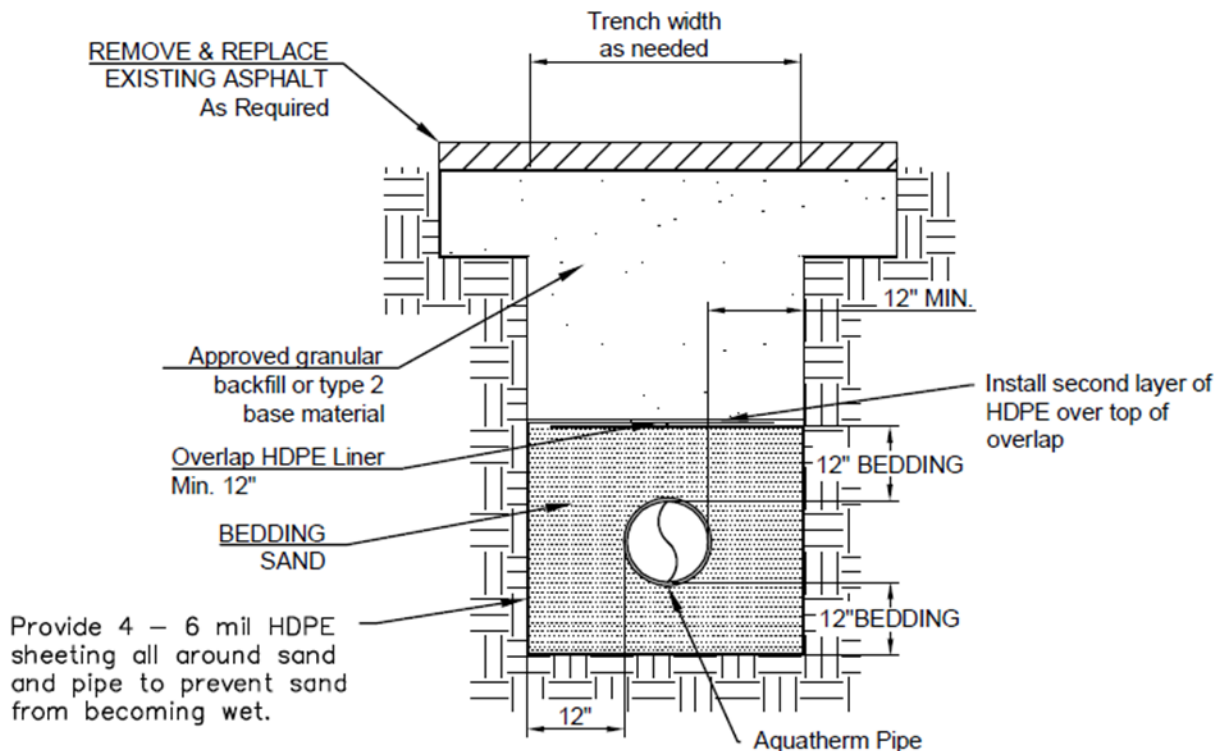


Figure 1: Sand as Insulation Detail

Revisions:

1. 29 September 2014 - Revised
2. 28 August 2024 - New template, added ASHRAE 2022 updates