

SPECIFICATIONS FOR DRILLING AND CASING BOREHOLES FOR P-S SUSPENSION LOGGING

1. Drilling must be done with minimal sidewall disturbance. We strongly recommend the rotary mud or rotary wash method. This method does little damage to the borehole wall, and the drilling fluid coats and seals the borehole wall reducing fluid loss and wall collapse. Drilling borehole diameter should not exceed the outer diameter of the casing by more than 100mm.
2. If the borehole must be cased, the casing must be PVC and properly installed and grouted. Any voids in the grout will cause problems with the data. Likewise, large grout bulbs used to fill cavities will also cause problems.
3. Casing must be about 100mm (4 inches) diameter, Schedule 40 PVC. This thickness and strength is necessary to minimize collapse due to the pressure of the grout. It is usually best to grout the casing while the casing is full of water to help minimize the differential pressure on the outside of the casing. The casing should be inserted with spacers or centralizers to keep the casing centered in the borehole.
4. The best way to grout the casing is through a small PVC pipe inserting through the casing and connected to a one-way ball-check valve in the bottom cap of the casing. Make sure the pump is capable of pumping grout all the way down to the bottom through the small pipe and up to the top of the borehole. Grout is then pumped down through the small pipe and fills up the annulus around the casing from the bottom to the top. Once the grout has filled the annulus around the casing up to the top, pumping is stopped, and the pipe disconnected from the valve and removed. The casing can be rinsed and flushed with water.

Alternatively, a small PVC pipe (1-1/2 inch, or 35mm), called a tremie tube, can be fed down the side of the casing between the casing and the borehole wall. Once the tremie tube reaches the bottom of the borehole, grout can be pumped through the tremie tube and grout filled from the bottom of the borehole.

Alternatively, the borehole can be partially filled with grout, and the capped casing forced down into the grout filled borehole until it reaches the bottom. Ideally the grout volume is calculated so that when the casing is fully inserted the grout is at the top of the borehole. In this method it helps to have the casing full of water.

All of these methods attempt to fill the annular space with grout all the way, top to bottom, with no voids, displacing the mud and debris with minimal sidewall disturbance.

5. The grout mixture should be formulated to approximate closely the density of the surrounding in-situ material after solidification.

For rock, use conventional portland cement that will harden to a density about 2.2Mg/m³ (140lb/cubic ft).

For soils, sands, or gravels, use a mixture with:

- 450g (1lb) bentonite
- 450g (1lb) portland cement
- 2800g (6.25lb) of water.

6. Keep the casing anchored and centered in the borehole until the grout is set. If shrinkage occurs, additional grout should be inserted from the top until the annular space is filled flush with the ground surface.
7. The grout must be set before testing. This means the grouting must take place at least 48 hours before testing.
8. Borehole fluid is required for the logging. The PVC must be filled with water prior to logging. If there is a leak, then water must be available to refill the borehole prior to and/or during logging. Major leaks cannot be allowed because the seismic noise accompanying such rapid water loss will obscure data and prevent data acquisition.

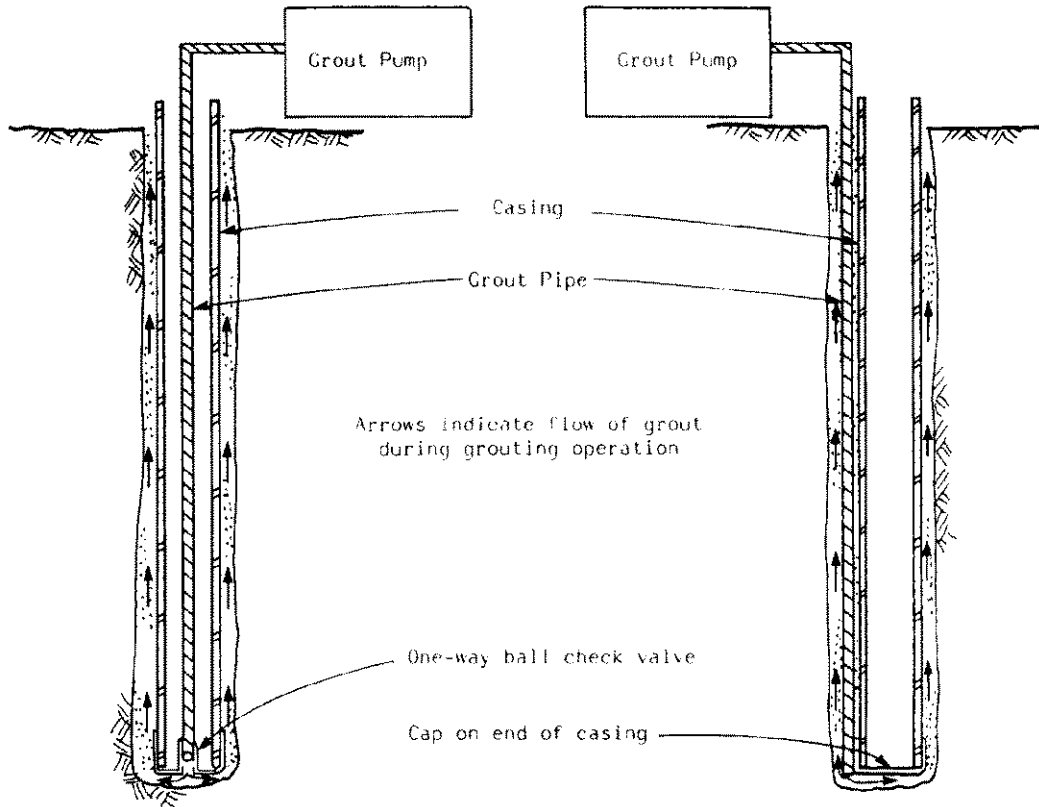


FIG. 4 Acceptable Grouting Techniques