

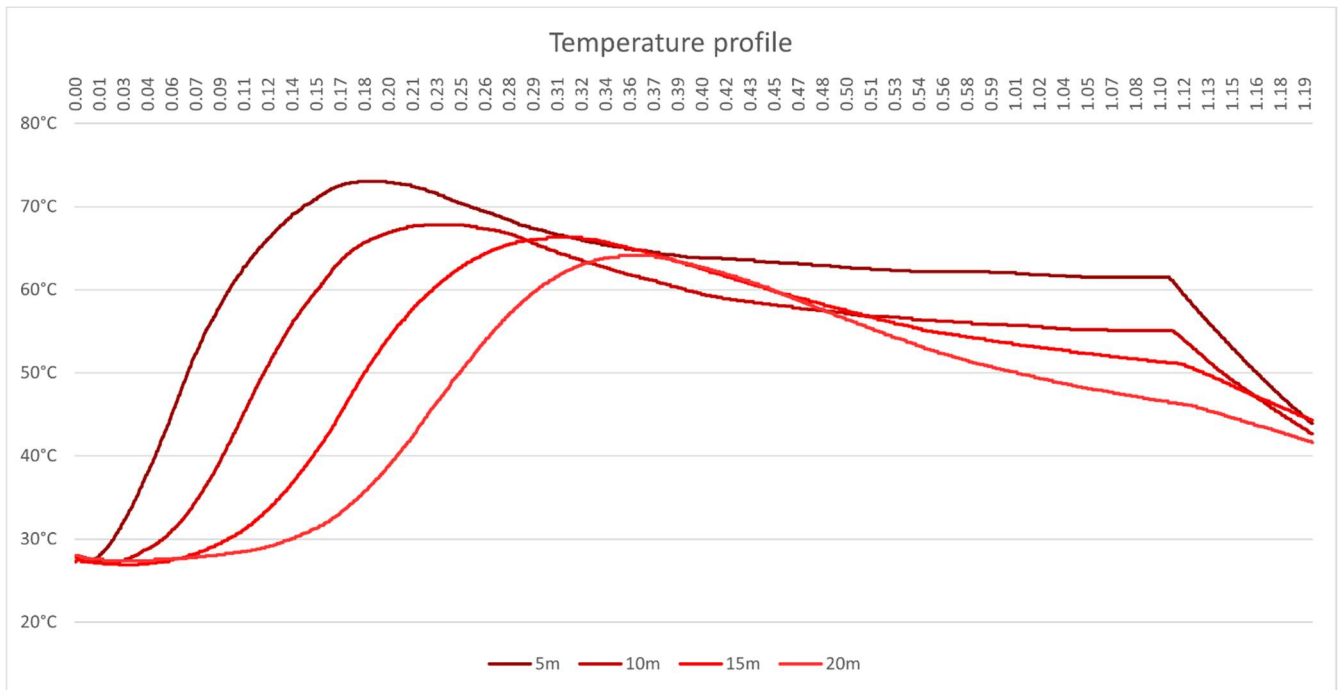
## Curing 21,5m / 70ft Liner in 70 minutes with Picote Midi Steamer

To test the performance of the Picote Midi Steamer, we attempted to steam a **21,5m DN100 /70ft 4" liner**. The liner was inverted into a DN100/4" PP-pipe that we had laid out on the floor in the workshop. We measured temperatures every **5m/16,4ft interval**, with a sacrificial probe in between the host pipe and the liner.

The Picote Midi Steamer was set to give a temperature output of **80°C/176°F**. We used the EU-configuration with 240V/15A. The pressure regulator at the steamer was set at **1,5 bar/23 psi** to compensate for flow, giving an actual pressure of approximately 0,5 bar/8 psi in the liner. We controlled the flow with the medium sized **150Lpm/5,3 CFM nozzle** on the DN100-DN150 Picote Steam end.

The resin we used has, as given by the manufacturer, an ambient **cure time of 13 hours in 22°C/72°F**. Our workshop had an ambient temperature of 19°C/66°F.

The test lasted 80 minutes total. However, the entire length of the liner was **cured in 70 minutes**. The scenario in the test was like curing a liner inside a building.



Test starts at 15:32. The liner was at a temperature of approx. 27°C /80°F when inverted in place. The probe data shows that the 150LPM/5,3CFM airflow is cooling the liner down, by dipping temperatures during the first minute of the test.

- Steam was introduced at 15:33 / 1 minute in.
- 18 minutes in, probe 1 at 5m/16,4ft reaches peak temperature 73°C /163°F.
- 22 minutes in, probe 2 at 10m/33ft reaches peak temperature 67,8°C /154°F.
- 30 minutes in, probe 3 at 15m/49ft reaches peak temperature 66,3°C /151°F.
- 35 minutes in, probe 4 at 20m/65,6ft reaches peak temperature 64,1°C /147°F.
- 35 minutes in, liner is cured at measurement point 1, 5m/16,4ft.
- 40 minutes in, liner is cured at measurement point 2, 10m/33ft.
- 50 minutes in, liner is cured at measurement point 3, 15m/49ft.
- 70 minutes in, liner is cured at measurement point 4, 20m/65,6ft, and at the end of the host pipe, 21,5m/70ft.
- 70 minutes in, steam is turned off and steamer starts the cool down of the liner.
- 80 minutes in, the test was ended at 16:52.

Additional notes:

- For this test we used the medium sized nozzle for the steam end. A smaller nozzle would lead to higher temperatures in the near end of the liner, but the heat would not be pushed as far down the liner in the same amount of time. Vice versa, a larger nozzle would lead to having the same heat dispersed further down the liner earlier.
- Which nozzle to use is dependent on what specification compressor one has. We recommend the nozzle that is no more than half of the given flow rate of the compressor in use. The smallest nozzle flows approximately 85LPM / 3CFM, the medium nozzle flows approximately 150LPM / 5,3CFM and the largest flows approximately 300LPM / 10,6CFM.
- In this test the liner was cured in approximately 70 minutes. That is over ten times faster than ambient with the resin we used. We may have been able to cure an even longer liner faster than ambient, but then we would likely be only warming up the liner, not steam curing it.
- We had the steamer set at 80°C / 176°F, to not have the reaction overshoot. If we would have had it set for too high, we likely would have had curing happen at a too high temperature. That, in turn may result in bursting the liner, deforming the host pipe and likely produce a very brittle liner.
- With the medium sized nozzle, we needed to have the steamer set at approximately 1,5 bar/23 psi to have 0,5 bar/8 psi in the liner. With the smaller 85LPM/3CFM nozzle the steamer would be set at approximately 0,9 bar/13 psi for that same 0,5 bar/8 psi in the liner.