

PVC Pipes at Low Operating Temperatures

PVC pipes are known to become less strong as the service temperature increases. For this reason, it is the practice to reduce the allowable operating pressure of PVC pressure pipes operating above 20°C. See PIPA technical report "Temperature derating of PVC pipes for pressure applications" (PV006).

On the other hand, the strength of PVC increases as the service temperature is reduced. Hence the ability to withstand internal pressure is greater at temperatures below 20°C¹. However, at the same time, the material becomes less tough and is more susceptible to impact damage.

It is not currently the practice in Australia to increase the operating pressure of PVC pressure pipes operating below 20°C. For example, a PN12 PVC pipe has a maximum allowable operating pressure of 1.2MPa at 20°C and at temperatures below this even though the strength is greater at lower temperatures.

The decrease in the impact resistance of PVC pipes at low temperatures is only a concern for those installations where impact might occur in service. A buried PVC pipeline is protected in normal service and only at risk of impact damage when excavations are carried out in the vicinity. Irrespective of the operating temperature, a buried PVC pipe would be damaged if struck by an excavator or backhoe. Any reduction in toughness at temperatures below 20°C is not going to be of great consequence.

In contrast, an above ground installation is might be struck with hand-tools, lifting or handling equipment or vehicles such as cars, trucks, or forklifts. That is, there can be more opportunity for above ground pipes to be subjected to impact. Therefore, above ground installations should be installed in locations where impacts from equipment or vehicles is minimised or the installation should be provided with mechanical protection, such as metal barriers. This applies particularly to pipes operating at low temperatures and which are therefore more susceptible to impact damage.

The effect of low temperatures on the toughness of PVC has not prevented PVC pipes from being used successfully in many applications carrying water and other liquids at temperatures well below 20°C. PVC pipes are being used successfully in Australia at temperatures as low as -10°C carrying glycol / water solutions in food and drink processing applications. For PVC pipelines carrying plain water, the minimum service temperature can be allowed to approach 0°C.

When installing PVC pipes at an ambient temperature higher than the operating temperature consideration has to be given to thermal contraction. The coefficient of thermal expansion of PVC is given as $7 \times 10^{-5} \text{ }^{\circ}\text{C}^{-1}$. Thus a 6m PVC pipe will contract by 8.4 mm if cooled from 20°C to 0°C. Australian / New Zealand Standard AS/NZS2032 – Installation of PVC Pipe Systems provides guidance on how to allow for expansion or contraction when installing pipes that are expected to operate at temperatures different from the installation temperature.

¹ Note that the nominal pressure (PN) or pressure class is based on performance at 20°C. At temperatures above 20°C the strength is reduced and at temperature below 20°C the strength increases.

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