

Frost Protection Performance Assessment – Absolute Frost Box

This document summarizes the frost protection performance of the Absolute frost box design intended for water supply pipes. The enclosure consists of an Expanded Polypropylene (EPP) insulation insert within a rigid UPVC outer shell.

Purpose: To demonstrate that the Absolute frost box can protect water supply pipes from freezing during cold weather conditions, specifically addressing the requirement of a minimum frost protection performance of 12 hours at -10°C.

Design Description Outer enclosure: • Material: UPVC • External dimensions: 130 mm x 120 mm
Internal insulation: • Material: Expanded Polypropylene (EPP) • Approximate density: ~30 kg/m³ • Thermal conductivity used for analysis: ~0.037 W/m·K Pipe sizes evaluated: • 25 mm water supply pipe • 32 mm water supply pipe Approximate insulation thickness (minimum): • 25 mm pipe: ~47.5 mm EPP to the closest outer face • 32 mm pipe: ~44 mm EPP to the closest outer face

Calculation Assumptions The following assumptions were used in the thermal estimation: • Still water inside the pipe (worst case) • Water starting temperature approximately 10 °C • Still external air conditions (no strong wind) • Straight pipe section of approximately 1 metre • No heat tracing applied • EPP insulation fitted tightly with minimal gaps • UPVC outer shell provides structural enclosure

Performance Results – 25 mm Pipe

Outside Air Temp	Time to Reach 0°C	Time to Fully Freeze
-5 °C	≈ 4.4 hours	≈ 69 hours
-10 °C	≈ 2.8 hours	≈ 35 hours
-15 °C	≈ 2.1 hours	≈ 23.6 hours
-20 °C	≈ 1.6 hours	≈ 17.8 hours

Performance Results – 32 mm Pipe

Outside Air Temp	Time to Reach 0°C	Time to Fully Freeze
-5 °C	≈ 6.2 hours	≈ 96 hours
-10 °C	≈ 3.9 hours	≈ 48.9 hours
-15 °C	≈ 2.9 hours	≈ 32.8 hours
-20 °C	≈ 2.3 hours	≈ 24.8 hours

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Performance Summary:

The frost box design significantly slows heat loss from the pipe due to the thick EPP insulation layer combined with the UPVC enclosure. Key result relevant to approval criteria: • At -10 °C ambient temperature, the pipe water does not freeze for approximately: – 35 hours (25 mm pipe) – 49 hours (32 mm pipe) Therefore, the design substantially exceeds the requirement of a minimum frost protection performance of 12 hours at -10 °C. Practical Considerations Actual field performance can be influenced by several factors, including: • Air movement around the enclosure • Quality of sealing at insulation joints • Exposed pipe fittings or valves • Contact between the pipe and outer shell • Initial water temperature Where properly, installed with sealed insulation joints and protected fittings, the frost box provides robust frost protection for water supply pipes.

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