Designing MV Joints for 2-bar water pressure

Practical principles for flood-resilient joint performance

Introduction

Flooding and rising groundwater levels are placing underground medium-voltage (MV) networks under sustained water exposure more often and for longer periods.
In these conditions, reliability is not defined by whether components can “get wet”, but by whether they can resist continuous hydrostatic pressure without allowing water ingress.
Field experience shows that joints are the dominant failure point under flooded conditions, making the outer sealing and encapsulation concept system-critical.
This document outlines practical design principles that enable MV joints to withstand hydrostatic water pressure up to 2 bar (approximately a 20 m water head) over long service periods.

What 2 bar hydrostatic pressure means in the field

Hydrostatic pressure is not a splash or short-term submersion scenario. It is a continuous force that pushes water into every available pathway: along interfaces, into micro-gaps, and through any connected porosity.
A joint can appear intact while still allowing slow moisture migration that later triggers electrical degradation. This is why “water resistance” must be understood as a system behaviour, not a single material claim.

Principle 1: Treat sealing as a system function, not a material property

A joint’s resistance to water pressure is created by multiple characteristics working together: flow behaviour during installation, curing behaviour, mechanical integrity, adhesion at interfaces, and long-term ageing stability.
If one element fails (for example, poor interface bonding or microcracks), hydrostatic pressure will exploit that weakness even when the bulk resin or housing material is inherently water resistant.

Principle 2: Controlled viscosity and sufficient working time enable complete filling

Reliable pressure resistance starts with installation behaviour. Resin viscosity must support complete wetting and filling of complex joint geometries so that no voids or unfilled gaps remain. The source document highlights viscosity and pot life as critical to ensuring accurate filling and elimination of voids, because air pockets are primary initiation sites for pressure-driven water ingress and partial discharge.

Sufficient working time enables careful, complete encapsulation and reduces the likelihood of interfacial defects.

Principle 3: Void-free encapsulation prevents connected pathways for water migration

Under pressure, water seeks the path of least resistance. Voids, air pockets, and unfilled gaps can form connected pathways that allow moisture to migrate deeper into the joint.

Void-free encapsulation is therefore essential, not only to block water migration but also to reduce the risk of partial discharge inception under wet conditions.

In flood-prone environments, “good enough filling” is not sufficient; pressure resistance requires consistently void-free continuity.

Principle 4: Bubble-free curing preserves structural continuity

Curing behaviour matters as much as initial filling. If curing produces bubbles, foaming, or connected porosity, hydrostatic pressure can exploit those microstructures as capillary routes for water migration.

The source document explains that bubble-free, non-porous curing is critical for long-term pressure resistance, and that formulation measures can be used to prevent bubble formation during curing in the presence of moisture.

The result must be a dense, continuous structure that does not provide capillary pathways for water.

Principle 5: Mechanical integrity and crack resistance protect sealing over time

Flood exposure is rarely the only stressor. Joints also face soil movement, settlement, vibration, and thermal cycling in service.
Even microcracks can become preferential pathways for water ingress under hydrostatic pressure.
That is why a balanced mechanical profile and long-term crack resistance are essential design targets for flood-resilient joints, not secondary considerations.

Principle 6: Adhesion is the dominant sealing mechanism at interfaces

In MV joints, water ingress occurs predominantly along interfaces rather than through bulk material.
Strong, durable adhesion to cable sheaths, housings, and metallic elements blocks longitudinal water migration and prevents interface tracking under pressure.
This is especially relevant for transition joints, where mixed materials increase interface complexity and the number of potential pathways for moisture migration.

Principle 7: Ageing stability ensures pressure resistance does not degrade

Long-term performance depends on how the sealing system behaves after years of thermal and hydrothermal exposure.
The source document emphasises retention of mechanical properties after thermal and water ageing, supporting the concept that sealing integrity must remain stable under combined heat and moisture exposure.
In practice, flood resilience is not only about surviving the first event, but about maintaining sealing performance across repeated exposures throughout the service life.

Conclusion
Designing MV joints for 2-bar hydrostatic water pressure requires a system approach: controlled filling behaviour, void-free encapsulation, bubble-free curing, durable adhesion at interfaces, crack resistance under mechanical stress, and stability after ageing. When these principles work together, joints can withstand sustained water pressure without creating pathways for moisture ingress that later trigger electrical failure.

Continue exploring

On the main page, you can explore practical methods for ensuring void-free installation quality, plus a compact selection guide that helps specification teams choose joint solutions for water-logged areas and complex interface applications such as transition joints.