



# BluSeal Tunnelling Tips

If you have ever wondered why engineering your tunnel waterproofing is so important, just try putting your hand over a bottle of water and turning it upside down. The water pressure would be around 100 times this for even the most basic tunnel application.

When waterproofing underground, water pressure resistance can be extremely challenging, so Bluey has put together a list of common issues that we can help to solve before you get started.

- 1 One of the first decisions is the membrane type and thickness. Bluey will look to International Standards, as well as our decades of experience in this area, to help you make the right decision. Not all membranes will work in all situations. This is where experience counts.
- 2 Terminating the cross-passage membrane to TBM segments had previously been one of the unsolved mysteries. The Bluey solution of engineered compression gaskets is now being adopted around the world and is leading the way in successfully solving this challenging problem.
- 3 Once the membrane is installed, there is almost always a requirement to apply fixings through the membrane. These could be required for reinforcement cages, formwork systems or services. Bluey has a range of suitable anchors which seal to the membrane, no matter how high the load.
- 4 Sealing around uplift piles is an often-overlooked problem. Simply terminating the membrane to the pile perimeter is not enough, as water will continue to rise through cracks in the top of the piles and through the voids around the reinforcement. Bluey have developed a unique capping system which will seal up to 100 m of water head at a pile location.
- 5 Terminating the waterproofing membrane to diaphragm walls and sheet piles can't be completed by simply applying 'glue' or liquid membrane. This high-pressure area is a common point of leakage if it is not sealed using an engineered gasket or suitable pressure termination.
- 6 Ground water pressure often needs to be relieved from behind the installed membrane, prior and during concrete casting. If this is not done successfully, then the membrane can tear during the final stages of pouring.
- 7 The membrane needs to be adequately 'quilted' during installation. Without the right amount of slack in the membrane, it will go into tension during pouring and tear at the seams. Alternatively, too much slack will create folds and create potential breakage points.
- 8 Fixing of the membrane to the tunnel surface is completed using a plastic roundel. Did you know that the weld to the roundel is designed to break under load before it tears the membrane? If the membrane does go into tension during the concrete pour, a properly welded roundel will not damage the membrane.
- 9 After concrete casting, there are almost certainly going to be voids remaining in the crown or high points. It is critical that these points are filled with second-stage grouting systems through pre-installed grout ports at the right locations. Bluey will design this system for your application.
- 10 It's important to select the right type of membrane based upon the expected 'ground-squeeze' after concrete placement. Bluey has completed testing on all our membrane systems so that we can provide engineering advice on the right type of membrane that will cope with the conditions.
- 11 During concrete pours, the formwork can lift due to buoyancy, creating extremely high forces. Bluey will engineer the right size and shape protection pad to protect the membrane in this area, depending on the size and shape of the formwork.





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- 12 There is often a need to design pipe and service penetrations to pass through the membrane. These are a common source of leakage if not addressed correctly with an engineered solution. Bluey has custom trumpets to suit a range of pipe penetration diameters.
- 13 Canopy tubes and lattice girders create a challenging surface for membrane application. The three-way curvature means that lots of extra welding is needed to manage potential areas for leakage. This can be a challenging point in any tunnel, to achieve a 100% water-tight seal. The right expertise will ensure the welded membrane is continuous in these areas.
- 14 Shotcrete application to sheet membrane has been an International challenge which was solved in Australia some years ago. Bluey, together with some clever project teams, developed a unique system for allowing large-scale application of this method to facilitate high-build and minimum rebound losses.
- 15 Once the membrane is installed, particularly in the invert, a protection system must be applied. Bluey will evaluate the project circumstances for likely traffic and other factors before recommending the right solution. This may be in the form of blinding concrete or as simple as a recycled membrane layer.
- 16 Ordering correct sheet roll lengths is often misjudged or overlooked. This decision is critical to minimising wastage, as the additional roll length results in an off-cut. However, if the rolls are too short, maybe as a result of over-break, then a significant amount of labour is required for extension. This is a critical decision on any project, which will impact the budget.
- 17 Waterstop spacing is an important detail for minimising risk. Compartmentalisation will limit the spread of leaks if damage occurs to the membrane during the service life. Following international standards for spacing is important. Looping and continuity of the water stop will provide long-term assurance.
- 18 Post-grouting systems are installed as part of a membrane system to provide a backup where structural movements may compromise the waterproofing systems. These also provide good assurance for the structure during its service life, if designed correctly.
- 19 Geotextile and drainage systems are key components of both drained and tanked systems. The geotextile has a two-fold job in protecting the membrane and allowing water to drain and equalise behind it. Selecting the right material and weight per square metre is important. Did you know that some geotextile material is not suitable for an alkaline environment?
- 20 In a drained tunnel, the position and detailing of drainage components will lead to the success or failure of the entire system. It is surprising how complex this can be and how often it can be designed incorrectly, resulting in leaks after completion.
- 21 External compartmentalisation needs to be installed where ground water movements on the outside of the membrane need to be prevented. This can be required to preserve water head around creeks to maintain ecology or, otherwise, around homes to prevent settlement. Detailing and effectiveness of various external compartmentalisation systems is not only important to the tunnel user but also to the surrounding communities.
- 22 Correct access equipment is critical to the success of any waterproofing project. Specialist access equipment can often be required, depending on the project requirements. The right access equipment will allow fast installation and getting the design right will result in installation cost savings.
- 23 Scheduling of waterproofing work is important to ensure that waterproofing works are coordinated appropriately and early in the design process. This can avoid costly rework and time delays during the construction process. Bluey understands construction sequencing and have a proud record of avoiding delays in concrete works.
- 24 It takes approximately five years to train a waterproofing installation technician. Bluey has established a plastics welding course in conjunction with PARTEC in Queensland, which is an independent, government-funded plastics and composites training college. We have proudly trained many young Australians to successfully work in the tunnel industry. Some of our original team from 2003 remain as Bluey employees, now training others.
- 25 Engineering is an important part of the waterproofing process. Bluey has three qualified, full-time engineers on its team who specialise in tunnel waterproofing. Our engineers work with the project design consultants to ensure that the detailing is in accordance with international standards. We consider ourselves an important part of the Australian tunnel community.

Contact Bluey on 1300 0 BLUEY or at [www.bluey.com.au](http://www.bluey.com.au) for more information



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