



## The History of Spiral Wound Pipe Technology In Australia's Pipe Renewal Industry

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Spiral wound pipe technology has been the most widely used product in the Australian pipe renewal market. Since the industry began in the late 1980's, more than half of all the pipes that have been relined in Australia have been relined with this technology.

The two companies that have become synonymous with this technology are Interflow and its technology partner Rib Loc and given that well over 95% of all the spiral wound pipe has been installed by Interflow, this article will focus on the evolution of the technology via the Interflow – Rib Loc partnership. It is important for completeness to acknowledge that the Danby spiral wound system has also been quite widely used over the last 20 years in the larger man entry sized pipes and continues to occupy a niche position today.

### 1. Spiral Wound Pipe – The 5 Key Benefits

Why have spiral wound pipes become so successful in this market and what are the main benefits to the installer and client?

#### Benefit #1 –Material Efficient

Spiral wound pipes are made from ribbed structures. This means they have a comparatively high strength to weight ratio. The principle is the same as that used in an I-Beam. This means that for any given stiffness, less material will be needed in a spiral wound liner than a comparative solid wall pipe or liner. The material efficient nature of spiral wound pipes is one of the keys to their cost effectiveness.

#### Benefit #2 – Minimally Disruptive

In the clear majority of circumstances spiral wound pipes are able to be installed in live flow and without by-passing. This is particularly attractive and beneficial to the client in many circumstances given the disruption by-passing can cause and in turn leads to the spiral wound systems being competitive in many situations.

#### Benefit #3 – Suitable Across Wide Diameter Range

Spiral wound pipes have been installed from 150mm to 3,000mm. The techniques are different as the diameters get larger but the basic principle of winding a ribbed profile into a pipe remains common to the technology. The versatility and risk profile of using spiral wound technology has been key to the longevity and sustainability of the products in a wide range of circumstances.

#### Benefit #4 – Mechanical Installation Process

The installation process involves mechanically locking adjacent strips of profile. There is no heat or curing. This has proven to be advantageous given the variable nature of the pipelines and the challenging circumstances the installer faces. The result is typically a low risk process where the installer is in control the whole time.



## Benefit #5 – Community and Environmentally Friendly

The installation process has a very small site footprint and is extremely non-disruptive to the residents. In most instances, their sewerage system will not be impacted in any way. Furthermore, the operation is relatively quiet; there are no chemical odours and no waste products. From an environmental perspective, the process is extremely benign, has a very low carbon footprint and is very safe.

### **2. Spiral Wound Technology – Expanda for Pipes 150mm to 900mm Diameter**

Expanda was developed and patented in the late 1980's by Rib Loc and first installed by Interflow in 1991. Expanda is an innovative spiral wound PVC product that produces a liner in intimate contact with the host pipe.

The Expanda process has been described in many articles before and won't be presented in detail again here, but the basic steps involve

- a. Spiral winding a PVC profile from one manhole to the next with a winding machine and cage.
- b. Upon reaching the downstream manhole the pipe is restrained and a wire is pulled from the downstream end towards the cage.
- c. The wire cuts a lock in the profile and by then feeding more profile into the machine the pipe is forced to expand diametrically until it contacts the host pipe.
- d. This continues until the pipe is fully expanded, upon which the machine is then removed, the ends are sealed and laterals are opened.

In the beginning Expanda was used for lining 300mm, 375mm and 450mm pipes and there were 2 profiles available. The winding equipment and cages were very simple and basic meaning that maximum length of line was limited to a little over 100m.

Also, the supporting equipment such as the hydraulic power pack was not portable meaning the site access was also somewhat limited.

Being very much in its infancy the limitations of the Expanda system were unknown and over the years Interflow developed installation techniques for situations such as

- Different manhole configurations
- Line lengths
- Line conditions
- Site access

Also, the technology (profile and machinery) were continuously improved such that the process became more robust, extrusion techniques were improved and the equipment design was continuously refined.

In the mid 1990's Rib Loc developed Expanda for pipes from 150mm to 300mm. Obviously this is the high-volume part of the market and it was important to develop the next generation of Expanda to be even more efficient and suitable for this market segment. The result was the Ramshorn technology and a range of light weight material efficient profiles.



The major advance with the Ramshorn technology was that the machinery was small and compact, meaning that the equipment was lighter and faster to get into and out of small access chambers but also very powerful such that lines over 200m in length were possible. The other unique feature was the winding cages were developed without the need to set or adjust the helix angle – instead the helix was built into the cage which was and still is a unique and innovative feature of the product and can result in less benching modification when using the product. The result was that Expanda was now able to competitively reline reticulation sewers.

In the early 2000's Expanda was further developed to be able to reline pipes from 450mm to 750mm. This involved developing a new profile type that was stiffer and had a new lock design that was capable of holding the extra torques in these sizes. Also, a new series of winding machines and cages were developed for these sizes, capable of bearing the extra loads and stresses imparted in these sizes. The other significant development in the early part of this decade was the development of the mobile power pack, control unit and winch. This mobile unit enabled Expanda installations to be performed in remote locations as quickly and efficiently as locations close to roads.

At the end of the 2000 decade and the early part of the current decade Expanda has been further developed to be able to reline pipes up to 900mm with plans in the near future to take this to 1200mm. This has been made possible by a further development of the drive trays, cages and power packs which has significantly increased the amount of drive meaning that longer and larger pipes are now capable of being wound and expanded. To date the largest pipe has been 220m of 750mm diameter (a weight of over 4 tonnes).

Despite being in the market for over 20 years Expanda has continued to evolve and develop. It has proven to be a versatile and effective solution for the vast majority of pipes from 150mm to 900mm. The product continues to be developed and Interflow is committed to pushing the boundaries of application and offering solutions that meet the clients' needs.

### **3. Spiral Wound Technology – Rotaloc for pipes 800mm to 1800mm Diameter**

The Rotaloc technology was developed by Rib Loc and first used by Interflow in 1999. Rotaloc is an innovative product for large diameter pipe relining. The Rotaloc process works as follows

- a. The Rotaloc machine is placed at one end of the line and fed with PVC profile
- b. The machine travels along the host pipe and forms a PVC liner behind it as it traverses
- c. The PVC liner is formed by mechanically locking the adjacent edges of the PVC profile
- d. Unlike the Expanda process the pipe does not rotate. Rather it is formed in situ and pressed out against the host pipe
- e. The machine travels from one manhole to the next. Upon reaching the downstream manhole, it is removed and the ends of the liner are sealed.
- f. Typically, the liner is then grouted in place to enhance its structural strength.

In the early years Rotaloc was a manual process, which involved a person "driving" the machine with a control pendant immediately in front of the machine. The person would manually control the speed and also the size of the liner.



By 2003 the second generation of the technology was developed by Rib Loc and released to the market. This machinery was automatic and controlled above ground by the operator. Additionally, the machinery was designed such that it automatically detected changes in the diameter of the pipe and adjusted the size of the liner to suit. Furthermore in the event of step changes in the host pipe, the machine could be reduced in size by the operator above ground. This generation has been extensively used by Interflow in the Australian and New Zealand market and won many project awards. Tens of kilometres of large diameter pipe have now been re-lined with Rotaloc and by far the majority of all large diameter pipes in the region have been lined with this product.

However, the development has not stopped. In the last 2 years Rotaloc has been enhanced such that it can now line around bends. In the last year nearly one kilometre of bends have been relined. This latest addition shows the versatility of the product and has eliminated one of the traditional gaps in the technology.

The existence of Rotaloc has made lining pipes larger than 1,000mm a low risk and routine exercise. Looking back 10 years, lining pipes of this size was considered a highly risky undertaking with several high profile failures in other parts of the world reverberating through the industry. The fact that it has now become so routine is a testament to one of the major benefits of spiral wound technology.

#### **4. Spiral Wound Technology – Ribline for pipes 400mm to 3,000mm diameter**

The Ribline technology was launched by Rib Loc and installed by Interflow in 2005. Ribline is the world's only steel reinforced polyethylene liner. Ribline is a fixed diameter spiral liner that is particularly applicable in situations where a very stiff liner is required.

The Ribline product and process is as follows

- a. The profile is made from polyethylene. It is ribbed and inside each rib is a strip of steel.
- b. The profile is wound through a machine and cage that is located in one manhole.
- c. The profile is extrusion welded together along its adjacent edges.
- d. The new pipe spirals its way from one manhole to the next.
- e. Upon reaching the downstream manhole the machine is removed.
- f. The pipe is then cement grouted

Another unique feature of Ribline is that the stiffness of the liner can be readily varied by simply changing the dimensions of the steel used in the profile. In this way, an optimum stiffness product can be produced for any given situation.

Since the product was first used in 2005 it has been used extensively for large diameter sewer and culvert renewals. It has also been continuously developed to meet greater and greater challenges. Of note were two award winning projects that demonstrated the world leading nature of Interflow and the product.

The first of these was the North Georges River Submain project in 2009 and 2010. This project involved renewing a 2,500mm sewer pipe with a 2,400mm liner. The distance between manholes was up to 700m. In order to line these lengths with a single liner, new technology was developed by Interflow. The result was the production of the world's largest continuous spiral pipe – being over 700m long and weighing over 100 tonnes. This achievement was recognised with Interflow receiving the International Society of Trenchless Technology Award for project of the year in 2010 as well as the ASTT project of the year award for 2009.



The second project involved the renewal of a 3,000mm diameter siphon. This was the largest pipe renewed in Australia and was further complicated by the fact that there were 2 bends to be negotiated. Interflow developed Ribline such that it is capable of lining bends. The scale of this project and the unique solution resulted in Interflow being awarded the ASTT project of the year for 2010.

The technology with Ribline, as with Rotaloc and Expanda, continues to be developed to meet the challenges of our industry.

#### **5. Spiral Wound Technology – SPR for non-circular pipes greater 800mm diameter**

In 2010, Interflow gained access to the SPR technology; a spiral wound solution for non-circular pipes. Despite not having been used in Australia yet, SPR via Sekisui has been widely used in the rest of the world, particularly Japan. SPR allows a conduit of essentially any shape to be structurally relined. The process is very similar to Rotaloc with the machine travelling through the conduit and leaving the liner behind. The liner is then grouted in place.

The SPR product completes the suite of spiral wound technologies offered by Interflow to the market and eliminates the last remaining section of sewer pipe renewal that spiral products have not been used in.

#### **6. Summary**

From its humble beginnings in the early 1990's, spiral wound technology has evolved to being a highly sophisticated technology that has been used in virtually every type of situation. The incredible versatility of the product and expertise of the companies involved in its development has seen the boundaries of the product stretched such that the projects undertaken in Australia are truly world leading.