

# CLOCK SPRING®

## Application Note Reinforcement Edge Effect

There are times when a single Clock Spring® is not wide enough to complete a repair. In this case, two or more units are used side-by-side (Figure 1), to cover the defect area and provide the 2-inch (50 mm) overlap specified for the repair. These units are spaced as close as possible with a maximum gap of 0.25 inches (6 mm). This gap is still reinforced because of a phenomenon called 'edge effect'.



Figure 1. Multiple Clock Spring® Units

Similarly, defects in bends can be reinforced with Clock Spring® but the repair is complicated by the radius of the elbow or fitting. In this case, the composite must be installed as narrow bands instead of the nominal 12-inch (305 mm) width to accommodate the shape of the elbow. This results in continuous reinforcement of the intrados but a separation of the bands on the extrados as can be seen in Figure 2a and 2b. The specification for a bend repair requires that this separation on the extrados not exceed 0.50-inches (13 mm). The width of the composite bands and the gap at the extrados are controlled by the geometry of the fitting. Bend repairs should be reviewed by a Clock Spring® representative to ensure adequate design.



Figures 2a, 2b. Reinforcement of Bends

The reinforcement provided by Clock Spring® does not stop instantly at the edge of the unit but rather decrease linearly over a short distance beyond the Clock Spring®. The rate of decrease of reinforcement with distance is complex and must be calculated using finite element analysis (FEA) and verified by full scale testing. This work was done for Clock Spring® repairs and is reported in GRI – 93/0346 "Clock Spring® Reinforcement of Elbow Fittings". The findings in this report are summarized in Figure 3.

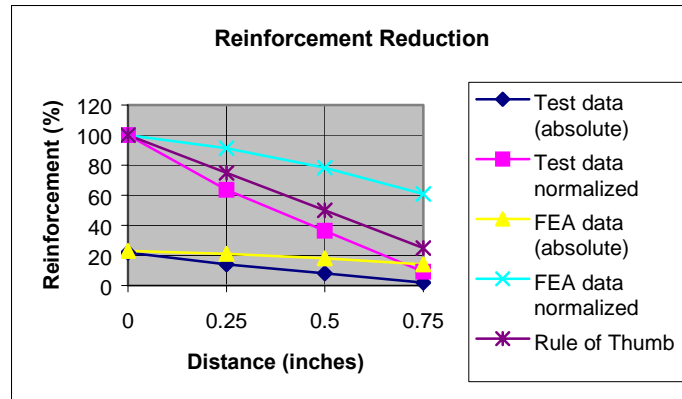


Figure 3.  
Reduction in Reinforcement Beyond Edge of Clock Spring®

Figure 3 shows both FEA and test data for the reduction in reinforcement past the edge of the Clock Spring® unit. The data is presented as absolute values and normalized to 100%. The 100% represents the reinforcement of a standard Clock Spring® unit.

The x-axis is distance from sleeve edge. That is, 0.25 inches (6 mm) represents the middle of a 0.5-inch (13 mm) gap. The 0.5-inch (13 mm) maximum gap specified for the extrados gap of a bend repair will still be adequately reinforced. Clock Spring Company has determined that as a "rule of thumb" the rate of reinforcement decrease can be approximated by 25% per 0.25-inches (4% per mm). This curve (normalized) is also shown in Figure 3.

When more than one Clock Spring® is used to reinforce defects in straight pipe the gap between the units is specified as 0.25 inches (6 mm). The edge effect ensures adequate reinforcement in the center of the gap.

**Simply the smartest pipeline repair decision you can make!**

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