

## Long-term deterioration of material properties of 3M Scotchkote spray liner products

### Introduction

The following fact sheet gives the results of tensile and flexural tests conducted on two 3M spray liner products: Scotchkote 269 and Scotchkote 2400, installed in 2009 and 2015 respectively, which were removed from in-service pipes.

The main objective was to evaluate the long-term performance of these liners under service conditions using available data from literature and results from the following tests conducted at Monash University.

### Methodology

#### Tensile tests

Tensile coupons were CNC cut from sample liners exacted from two in service CICL pipes obtained from the field.

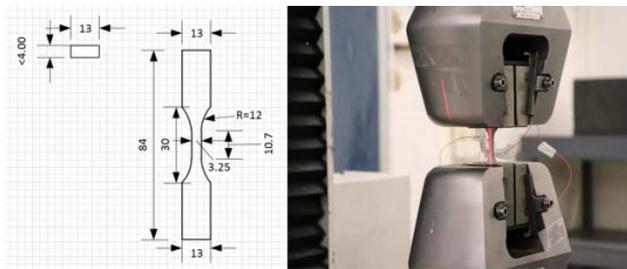


Figure 1: Tensile test specimen dimensions and apparatus

Six tensile tests (Figure 1) for each liner were conducted according to the ASTM D638 (2014) standard.

Test parameters are as follows:

- Specimen direction: along the longitudinal axis
- Test speed: 1 mm/min

Specimens were machined flat on the exterior side only.

#### Flexural tests

Rectangular flexural specimens were cut from the same

samples extracted from the two liner types.

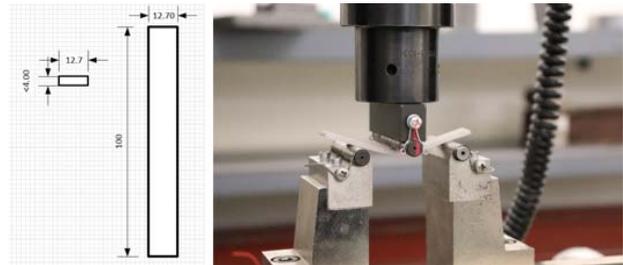


Figure 2: Flexural test specimen dimensions and apparatus

Six flexural tests (Figure 2) for each liner were conducted according to the ASTM D2990 (2001) standard.

Test parameters are as follows:

- Specimen direction: along the longitudinal axis
- Test speed: 2 mm/min

Specimens were machined flat on the exterior side only. Specimens were flexed in both directions, with the machined flat side on the bottom and the curved side on the bottom for comparison. No distinct variation was observed in the results from testing direction.

### Results

#### Tensile tests

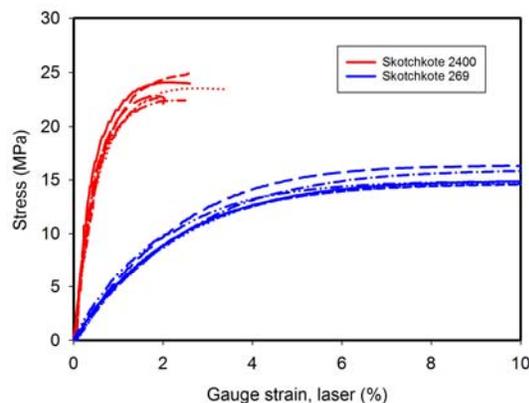


Figure 3: Tensile test results for two ex-service 3M spray liners

## Flexural tests

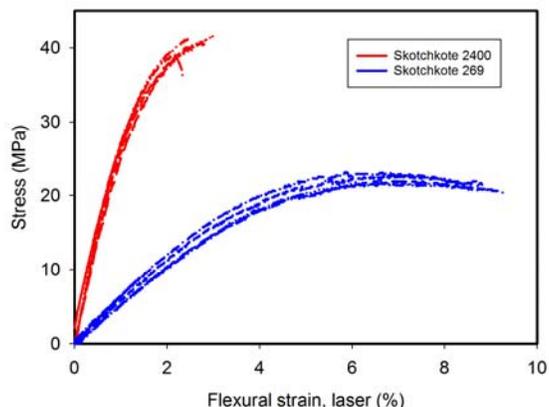


Figure 4: Flexural test results for two ex-service 3M spray liners

## Comparison with previous results

The strength properties of the two liner products tested were obtained from literature. Since the two liners were in-service for 10 and 4 years respectively, an assessment could be made regarding the deterioration rates of the material properties.

Table 1 provides the initial material properties obtained from literature along with the values reported by 3M compared against the results from the present investigation.

Table 1: Comparison of liner material properties (2400 is highlighted in red, 269 is highlighted in blue)

	Tensile strength (MPa)	Flexural strength (MPa)	Tensile modulus (MPa)	Flexural modulus (MPa)
Skotchkote 2400 (3M, 2011)	39	58		3620
Skotchkote 2400 Initial (YVW, 2015)	34.1	53.1		
Skotchkote 2400 Present Study	23.4	40.8	3700	3014
Skotchkote 269 Initial (Matthews et al, 2012)	19-24	17-22.4	310-461	720
Skotchkote 269 Present Study	15.3	22.3	894	580

## Other Observations

The older liner (269) showed signs of de-bonding from the host pipe (Figure 5), which could have occurred with time and deterioration of the liner material or due to external factors such as water intrusion. This needs to be investigated further.



Figure 5: De-bonding of liner and corrosion products between liner and cement liner (Skotchkote 269)

## Conclusions

A decrease in tensile strengths of both liner products were observed compared with original values. The flexural strength of the Skotchkote 269 liner however appears not to have changed significantly, although the 2400 liner shows a decrease in its flexural strength. The possibility of water, chlorine or internal pressure leading to strength degradation needs to be evaluated based on this data.

## References

- 3M (2011). 3M™ Scotchkote™ pipe renewal liner 2400, Design and application guide, 3M, MN, USA
- Matthews, J., Selvakumar, A., Condit, W., and Sterling, R. (2012). Demonstration and evaluation of an innovative water main rehabilitation technology: Spray-on polymeric lining. *Water Practice & Technology*, 7(1): 1–15.
- Yarra Valley Water (2015). Spraylining for water main renewals trial, Yarra Valley Water, Mitcham, Victoria, Australia.