

## LABORATORY TEST REPORT

**Subject:** EXAMINATION OF INFINITY CABLE ex [REDACTED]  
RESIDENCE, ACCC PRJ100178.

**UQMP Project No.** C01803.01

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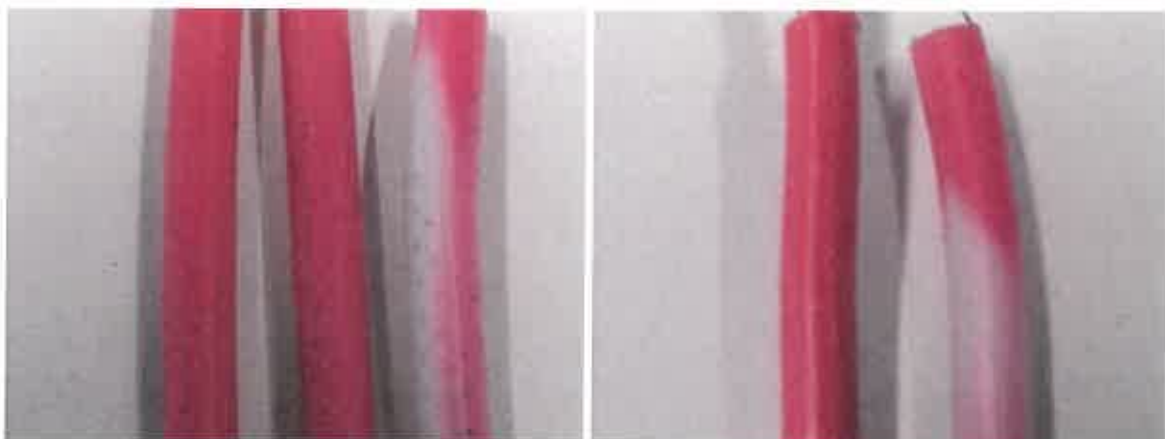
**Date:** 20 April 2015

**Sample Description:** Two pieces of Infinity cable, 450/750V FT3015  
1.5 mm<sup>2</sup> X2C + E ACCC PRJ100178 EV105972 :-  
Labelled #1 (UQMP lab # 13364)  
Labelled #2 (UQMP lab # 13365)

**Method Ref:** AS NZS 1660.2.1 Test methods for electric cables Method 2.1  
Insulation, extruded semi-conductive screens and non-metallic  
sheaths—Methods for general application

### Laboratory Report Summary:

The two pieces of cable had been supplied for examination following concern about the fading of colour noted on the exposed red core insulation.



**Fig. 1.** Red core removed from sheath. The left hand image shows the fading to be worse to one side of the insulation. The right hand image shows the boundary between faded and normal mimics the cut angle of the sheath. (NB: dark speckles are due to the tensile tester grips)

Slices through the insulation show that the red and black core insulation has been coloured by application of dye, or less likely co-extruded coloured compound, to the outside of a basic white PVC compound. The yellow-green earth core was formed by co-extrusion of yellow and green compounds.

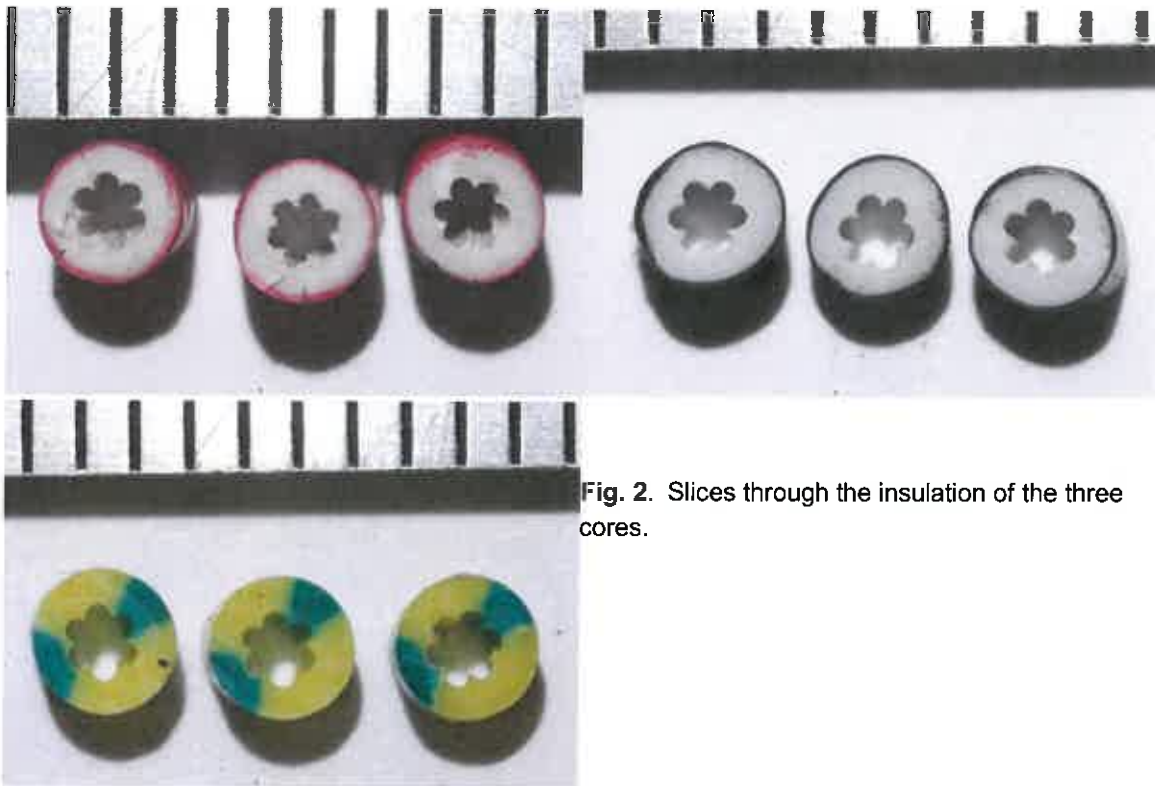


Fig. 2. Slices through the insulation of the three cores.

The core section displaying fading is shown below at higher magnification:



Fig. 3. Red faded core immersed in oil to minimise light scatter. The red colour is not very uniform around the circumference. However, loss of colour from the very outside layer is seen (arrowed).

No sign of yellowish discolouration was noted but this would not begin until significant thermal degradation had occurred. Subjectively the insulation was quite flexible. However, the ultimate test was to determine the mechanical properties in accordance with AS

1660.2.1. This is the relevant standard which is called by AS NZS 3808 - 2000 *Insulating and sheathing materials for electric cables (inc amdt 1&2)*. The two faded ends were just over 10 cm long, the length required for tensile testing, and were run separately to the cohort of 5 specimens required by the standard for replicates. Thus 5 specimens from each of the three cores from the two cable samples were prepared for tensile testing to determine the mechanical properties of the cable insulation. The results are shown in the table below:

SAMPLE	TENSILE STRENGTH		ELONGATION	
	Avg 5 runs	Range	Avg 5 runs	Range
Red #1	14.2	14.1 – 14.3	234	211 – 241
Red #2	13.9	13.6 – 14.0	234	213 – 241
Red avg of 1 & 2	14.1	13.6 – 14.3	234	211 - -241
Red faded #1 <sup>α</sup>	14.6		265	
Red faded #2	14.1		258	
Black #1	14.7	14.5 – 14.8	258	236 – 278
Black #2	14.2	13.8 – 14.6	258	213 – 286
Black avg of 1 & 2	14.4	13.8 – 14.8	258	213 – 286
Black exposed #1 <sup>β</sup>	14.7		248	
Black exposed #2	14.6		261	
Yellow-Green #1	13.9	13.8 – 14.1	205	179 – 219
Yellow-Green #2	14.2	14.1 – 14.2	203	178 – 230
Yellow-Green avg of 1 & 2	14.2	13.8 – 14.2	204	178 – 230
Yellow-Green exposed #1 <sup>β</sup>	14.1		219	
Yellow-Green exposed #2	14.1		213	

<sup>α</sup> The faded ends which had been noted by the householder were tested extra to the 5 specimens run for the tensile strength determination.

<sup>β</sup> The ends which were adjacent to the faded red core were tested as part of the cohort of 5 specimens run for the tensile strength determination but the result was noted for comparison.

The AS NZS 3808 requirement is that the new insulation achieves as a minimum:

Tensile Strength (MPa)	12.5
Elongation at Rupture (%)	150

All three cores in both samples achieved the required mechanical performance. Both faded samples also required mechanical performance. The black and yellow-green cores which were parallel to and exposed just as the faded red core had been, were also run within the cohort of 5 replicates for each colour. These samples also achieved the required mechanical performance.

Unfortunately, baseline results for the insulation are not available. However, work done by TUV Rheinland in January 2014 reported the following results:

CABLE	TENSILE STRENGTH (MPa)	ELONGATION (%)
Electra cables RF3025 2.5 mm <sup>2</sup> X2C+E	Red: 14.06	215.8
	Black: 14.49	213.6
	Ye-Gr: 13.64	213.0
Olex 070 M E21 1.5 mm <sup>2</sup> X2C+E	Red: 13.94	267.9
	Black: 15.07	256.9
	Ye-Gr: 13.71	247.8
Prysmian L 2013 2.5 mm <sup>2</sup> X2C+E	Red: 16.55	266.8
	Black: 15.82	248.2
	Ye-Gr: 16.13	255.2
Olsent 100238403 2.5 mm <sup>2</sup> X2C+E	Red: 15.85	229.1
	Black: 16.22	218.9
	Ye-Gr: 15.28	215.6
Infinity (various)	Not determined since the aged sample was too brittle to test	

The submitted samples compare favourably with the new cable results for different brands. It is noted that degradation of the insulation generally sees the tensile strength increase and the elongation decrease. The tensile values for the samples is slightly lower than these different brands and the elongations are comparable.


Why then has the red core faded? As described above, the Infinity cable has been coloured only at the surface. The most economical way to do this is using a solution of a dye. Dyes are organic chemicals and tend to have inferior UV, oxidation and thermal stability to pigments which are usually mixed into the PVC compound producing colour throughout. The sample cable was, according to the home owner, installed in the ceiling but the exact configuration is unknown. Possible environmental factors which may have caused fading of the red dye from the outside to inside are:

- Mounting within a light fitting can expose the cable end to UV light, heat and, if a high voltage transformer is use, there may be ozone.
- Radiant heat from roofing
- Nitrogen oxides from heating appliances

If the cable insulation had been experiencing degradation due to use, it is expected that any heat-induced fading would be more likely to be from the inside to the outside.

In short, there is no evidence at all to suggest there has been significant degradation of the Infinity samples supplied.

**Signed for and on behalf UQ Material Performance**




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Jim Haig

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