1. OBJECTIVE

As part of the MOC 2312 comparative test according to FORD ES-KU5T-1A303-AA specification of the 250 standard vs 250 coated in Valence.

2. TEST PARTS

- Product reference: 250
- Manufacturer: Scapa
- Batch number: 250 batch 1894341 / 250 batch PI2312
- Temperature class: -40°C to 150°C
- Backing material: Aluminized glass cloth
- Adhesive type: Silicone
- Colour: Silver
- Sizes: 19mm
- Part identification: **ES-KU5T-1A303-AA (D1R-10)**
- Thickness: 0.200mm
- Weight: 224gm²
- Roll diameter: 89mm

3. TEST METHODS USED: FORD ES-KU5T-1A303-AA Let H March 2023

4. TEST CONDITIONS: 23 ± 2°C, and 50±5% of relative humidity. (Unless otherwise specified)

5. PERSONN IN CHARGE OF TEST AND FUNCTION Pierre Tissot, Senior Testing Specialist - Automotive

6 OBSERVATION

Evaluations were done in principle on the test parts. An analysis using the images of the test report is not possible, as by various external influences a distortion of the photographic documentation could be. (e.g. exposure, illumination, print settings, ...).

Deviations from operating procedures are indicated in italics highlighted in grey.

7 RESULTS

7.1 LEGEND

	Test passed
	Test carried out (Requirement to be defined)
	Test failed
	Test result has to be interpreted
	Not tested
	No test required according to this standard

7.2 MATRIX OF TEST

Tests	Section	Unit	Requirement	Result		Page
				250 standard	250 PI 2312	
TAPE REQUIREMENTS - PHYSICAL PROPERTIES						
Tensile strength	5	N/cm	>115	**196.8**	**195.8**	**3**
Elongation	5	%	<10	**6.9**	**7.3**	**3**
Adhesion on steel	5	N/cm	≥2,0	**5.4**	**5.0**	**4**
Adhesion on backing	5	N/cm	≥2,0	**4.9**	**4.6**	**5**
PERFORMANCE REQUIREMENTS – BUNDLING PERFORMANCE AND MATERIAL COMPATIBILITY						
Initial testing	7.3.1	/	No cracking or flagging.	**Comply**	**Comply**	**6**
Environmental cycling	7.3.2		See protocol			**7-8**
Tyco Raychem ACW0219				**Comply**	**Comply**	
Heat ageing 3000h at 150°C	7.3.3		See protocol			**9-13**
Tyco Raychem ACW0219				**Comply Class D**	**Comply Class D**	
Thermal overload 6h at 200°C	7.3.4		See protocol			**14-15**
Tyco Raychem ACW0219				**Comply**	**Comply**	
Material compatibility	7.3.5					**16 to 22**
Environmental cycling						
Tyco Raychem ACW0219			See protocol	**Comply**	**Comply**	**17**
Heat ageing 3000h at 150°C						
Tyco Raychem ACW0219			See protocol	**Comply**	**Comply**	**18-21**
Thermal overload 6h at 200°C						
Tyco Raychem ACW0219			See protocol	**Comply**	**Comply**	**22**
Fluid resistance	7.4		See protocol	**Compliant on all fluids**	**Compliant on all fluids**	**23 to 26**
Cold flexibility 4h at -40°C	7.5		No cracking or degradation.	**Comply**	**Comply**	**27-28**
Fogging	7.6	%	>20	**100**	**99**	**29**
Flammability	7.7	mm/min	≤100	**0**	**0**	**30-31**
Odor rating	7.8	Class	≤2			**32**
Reserved	7.9					
Noise dampening	7.10	dB Class	Class 1	**2.1 Class 1**	**2.4 Class 1**	**33**
Abrasion resistance	7.11	Cycles Class	Class 0	**Class 0**	**Class 0**	**34**
Thermal effectiveness	7.12	°C	Se at 121°C	**Not tested**	**Not tested**	**35 to 36**
			Se at 260°C	**Not tested**	**Not tested**	
			Se at 482°C	**93.3**	**89.3**	
Dielectric performance	7.13	/	N/A			
Tape color	8.1	/	Silver	**Silver**		**36**

5 Tape requirements

5.1 Tensile strength and elongation

Apparatus

Dynamometer MTS 2/M with sensor 1KN

Procedure

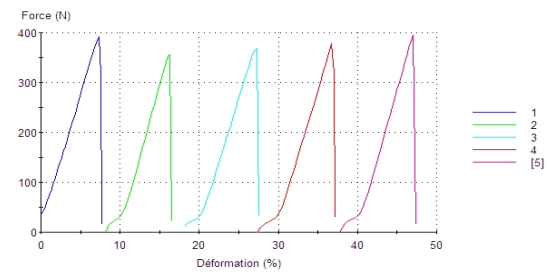
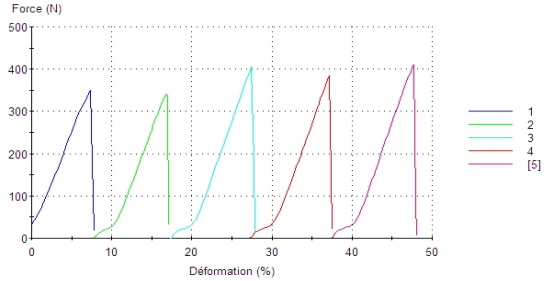
ASTM D1000 (300mm/min; 100mm between jaws)

Requirement

Tensile strength: Scapa requirement approved Ford > 115N/cm
Elongation: Scapa requirement approved Ford < 10%

Result

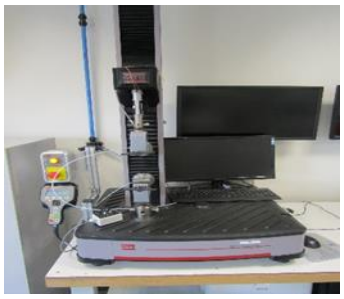
Roll	250 Standard	250 PI2312	Approval	250 Standard	250 PI2312	Approval
	Tensile strength (N/cm)			Elongation (%)		
1	205.3	179.7	COMPLY	7.3	7.4	COMPLY
2	182.8	175.4		6.3	6.7	
3	191.6	210.2		7.3	7.5	
4	199.8	198.1		6.7	7.1	
5	204.5	215.7		7.0	7.7	
Min	*182.8*	*175.4*		*6.3*	*6.7*	
Max	*205.3*	*215.7*		*7.3*	*7.7*	
Mean	**196.8**	**195.8**		**6.9**	**7.3**	

250 Standard	250 PI2312
	

5.2 Adhesion on steel

Apparatus

Dynamometer MTS C42.503E n°1448 with sensor 100N n° 1449
Automatic applicator rolls
Stainless steel type 304 with final bright annealing treatment and surface roughness of 50 nm ± 25 nm.



Procedure

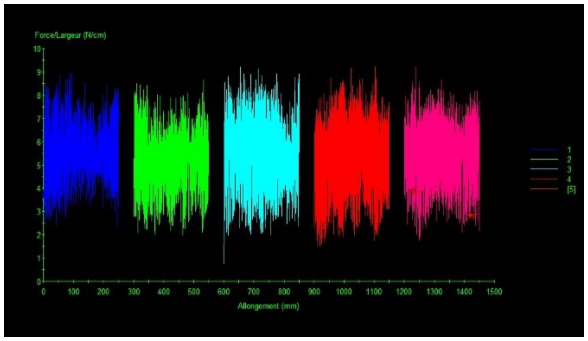
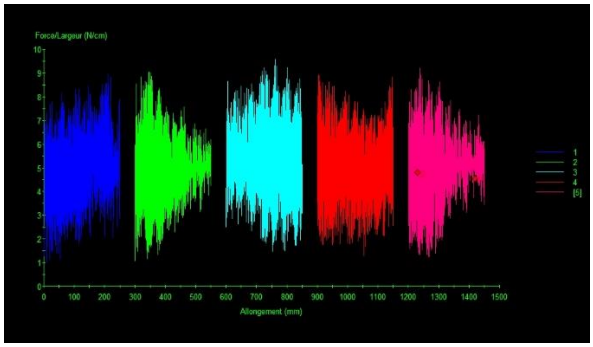
ASTM D1000
Test after 20min at 23°C, at 180°, 300mm/min

Requirement

Adhesion on steel: Scapa requirement approved Ford ≥2.0N/cm

Result

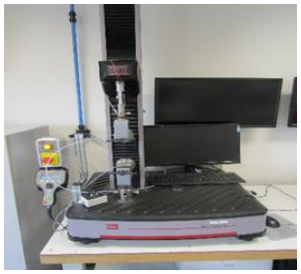
Roll	250 Standard	Approval	250 PI2312	Approval
	N/cm		N/cm	
1	5.6	Comply	5.0	Comply
2	5.2		4.9	
3	5.5		5.3	
4	5.5		4.8	
5	5.4		5.0	
Min	***5.2***		***4.8***	
Max	***5.6***		***5.3***	
Mean	**5.4**		**5.0**	

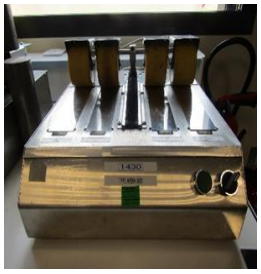
250 Standard	250 PI2312
	

5.3 Adhesion on Backing

Apparatus

Dynamometer MTS C42.503E n°1448 with sensor 100N n° 1449
Automatic applicator rolls
Stainless steel type 304 with final bright annealing treatment and surface roughness of 50 nm ± 25 nm.





Procedure

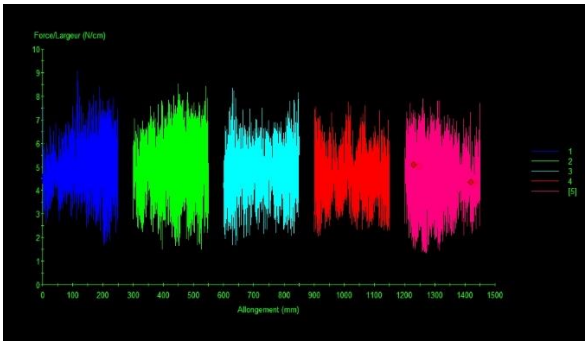
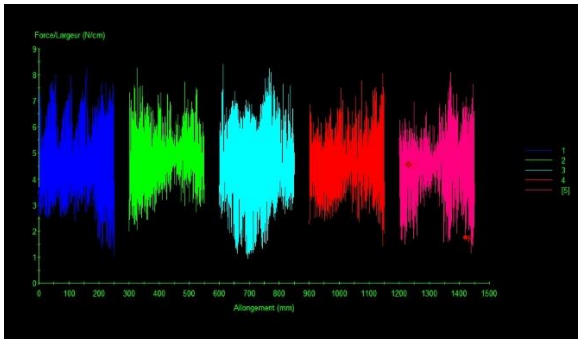
ASTM D1000
Test after 20min at 23°C, at 180°, 300mm/min

Requirement

Adhesion on steel: Scapa requirement approved Ford ≥2.0N/cm

Result

Roll	250 Standard	Approval	250 PI2312	Approval
	N/cm		N/cm	
1	5.1	Comply	4.5	Comply
2	5.2		4.8	
3	4.9		4.6	
4	4.7		4.5	
5	4.7		4.6	
Min	***4.7***		***4.5***	
Max	***5.2***		***4.8***	
Mean	**4.9**		**4.6**	

250 Standard	250 PI2312
	

7.3 Bundling performance and material compatibility

7.3.1 Initial testing

Apparatus

40mm diameter mandrel
Wires Tyco Raychem ACW0219 0.35²

Sample preparation

Assemble bundles 300 mm or greater (300 to 450 mm recommended) in length of wire using two (2) 0.35 sq. mm wires; the wires are to be twisted. The insulation on the wires must have a temperature rating equal to or greater than the temperature rating of the tapes being tested. Wrap the tape to be tested around the bundle with a 50% overlap of Scapa XXXX.
After assembly, specimens shall be allowed to stabilize for a period of 20 minutes prior to testing.

Test conditions

- Ambient climate 23°C/50%RH
- Sample length: 300 to 450mm
- Number of twisted cables 2
- Cable twist length ca. / approx 2 cm
- Overlap of tape ca. / approx 50 %
- Number of samples 1
- Conditioning Min 20min at 23°C / 50% RH
- Winding test:
  - Test climate 23°C/50% RH
  - Mandrel diameter: 40mm
  - Number of windings min 2

Procedure

After 20min at 23°C / 50% RH, the bundle specimen shall be bent about a 40 mm diameter mandrel.

Requirements

The tape shall show no indications of cracking or flagging at the ends.

Results

Specimen	Results		Approval
250 Standard		No cracks or flagging	**Comply**
250 PI2312		No cracks or flagging	**Comply**

7.3.2 Environmental cycling

Apparatus

Climatic chamber ACS DM340
40mm diameter mandrel
Wires Tyco Raychem ACW0219 0.35²

Sample preparation

Assemble bundles 300 mm or greater (300 to 450 mm recommended) in length of wire using two (2) 0.35 sq. mm wires; the wires are to be twisted. The insulation on the wires must have a temperature rating equal to or greater than the temperature rating of the tapes being tested. Wrap the tape to be tested around the bundle with a 50% overlap of adhesive tape.
In addition one control sample bundle (wire without tape) shall be prepared to aid in the evaluation of wire color.
After assembly, specimens shall be allowed to stabilize for a period of 20 minutes prior to testing.

Test conditions

- Ambient climate 23°C/50%RH
- Sample length: 300 to 450mm
- Number of twisted cables 2
- Cable twist length ca. / approx 2 cm
- Overlap of tape ca. / approx 50 %
- Number of samples 3
- Conditioning Min 20min at 23°C / 50% RH
- Winding test:
    - At the end of climatic cycles and after reconditioning 4h at 23°C/50% RH
    - Mandrel diameter: 40mm
    - Number of windings: 1

Procedure

Subject the specimens to 7 cycles of the following regime:

- 3 h at service temperature
- 2 h period of uniform cool-down to -40 ± 2 °C
- 3 h at -40 ± 2 °C
- 1 h uniform heat-up and humidification to 38 ± 2 °C, and 95 to 98 % R.H.
- 1 h at 38 ± 2 °C, and 95 to 98 % R.H.
- 1 h uniform heating and drying to service temperature

After 7 exposure cycles are completed, one specimen shall be removed from the chamber and then bent about a 40 mm diameter mandrel. Visually inspect the specimen for any cracks, tears, melting, loss of or other forms of degradation. Measure the length of the tape ends that are flagging, if any.
The remaining specimens shall be reconditioned at 23 ± 5 °C and 50 ± 5 % RH for a period of 4 hours. After reconditioning is complete, bend the specimens about a **40 mm** diameter mandrel. Visually inspect the specimens for any cracks, tears, melting, loss of adhesion or other forms of degradation. Measure the length of the tape ends that are flagging, if any.
Record and report any change in appearance and signs of degradation.
All specimens from this test (Post-test) shall be used to execute the material compatibility test.

Requirements

a) No cracking, melting or degradation.
b) Flagging maximum 10mm.
c) The adhesive tape should still exhibit self-adhesive properties. Reduced adhesiveness as compared to the unaged sample is permitted; full hardening or adopting a paint-like condition is, however, not permitted. The aged sample wiring harness may be sticky; however, the adhesive shall not be transferred to clean fingers.
d) Noticeable discoloration of the adhesive tape is not allowed. The color of the aged and of the unaged tape shall be documented in photographic form.

Results

250 standard

Specimen	Requirement a)	Requirement b)	Requirement c)	Requirement d)
1	No cracking, melting or degradation	0mm flagging	Sticky adhesive Non-sticky harness	No noticeable discoloration of tape
2	No cracking, melting or degradation	0mm flagging	Sticky adhesive Non-sticky harness	No noticeable discoloration of tape
3	No cracking, melting or degradation	0mm flagging	Sticky adhesive Non-sticky harness	No noticeable discoloration of tape

Requirement		Specimen 1	Specimen 2	Specimen 3
a b				
d	Unaged			

250 PI2312

Specimen	Requirement a)	Requirement b)	Requirement c)	Requirement d)
1	No cracking, melting or degradation	0mm flagging	Sticky adhesive Non-sticky harness	No noticeable discoloration of tape
2	No cracking, melting or degradation	0mm flagging	Sticky adhesive Non-sticky harness	No noticeable discoloration of tape
3	No cracking, melting or degradation	0mm flagging	Sticky adhesive Non-sticky harness	No noticeable discoloration of tape

Requirement		Specimen 1	Specimen 2	Specimen 3
a b				
d	Unaged			

7.3.3 Thermal ageing 3000h at 150°C

Apparatus

Oven Climats XU250
Wires Tyco Raychem ACW0219 0.35²

Sample preparation

Assemble bundles 300 mm or greater (300 to 450 mm recommended) in length of wire using two (2) 0.35 sq. mm wires; the wires are to be twisted. The insulation on the wires must have a temperature rating equal to or greater than the temperature rating of the tapes being tested. Wrap the tape to be tested around the bundle with a 50% overlap of Scapa 2630.
In addition one control sample bundle (wire without tape) shall be prepared to aid in the evaluation of wire color.
After assembly, specimens shall be allowed to stabilize for a period of 20 minutes prior to testing.

Test conditions

- Ambient climate 23°C/50%RH
- Sample length: 300 to 450mm
- Number of twisted cables 2
- Cable twist length ca. / approx 2 cm
- Overlap of tape ca. / approx 50 %
- Number of samples: 5
- Conditioning Min 20min at 23°C / 50% RH
- Winding test:
    - At the end of each ageing period and after reconditioning 4h at 23°C/50% RH
    - Mandrel diameter: 20mm
    - Number of windings: 1

Procedure

20 specimens shall be placed in a suitable high temperature air-circulating oven capable of 8-20 air changes per hour. Specimens shall be exposed to their operable service temperature for a period of 3000 hours.
From 1500h this every 500h, take 5 specimens, bend the specimen around a mandrel with a diameter of 20 mm at a uniform rate of one turn per 10 seconds. Visually inspect the specimens for any cracks, tears, melting, loss of adhesion or other forms of degradation. Measure the length of the tape ends that are flagging, if any. Record and report any change in appearance and signs of degradation.
All specimens from this test (Post-test) shall be used to execute the material compatibility test.

Requirements

a) No cracking, melting or degradation.
b) Flagging maximum 10mm.
c) The adhesive tape should still exhibit self-adhesive properties. Reduced adhesiveness as compared to the unaged sample is permitted; full hardening or adopting a paint-like condition is, however, not permitted. The aged sample wiring harness may be sticky; however, the adhesive shall not be transferred to clean fingers.
d) Noticeable discoloration of the adhesive tape is not allowed. The color of the aged and of the unaged tape shall be documented in photographic form.

Results

250 standard

Duration	Specimen	Requirement a)	Requirement b)	Requirement c)	Requirement d)
1500h	1	No cracking, melting or degradation	No flagging	Adhesive with tack	No color change
	2	No cracking, melting or degradation	No flagging	Adhesive with tack	No color change
	3	No cracking, melting or degradation	No flagging	Adhesive with tack	No color change
	4	No cracking, melting or degradation	No flagging	Adhesive with tack	No color change
	5	No cracking, melting or degradation	No flagging	Adhesive with tack	No color change
2000h	1	No cracking, melting or degradation	No flagging	Adhesive with tack	No color change
	2	No cracking, melting or degradation	No flagging	Adhesive with tack	No color change
	3	No cracking, melting or degradation	No flagging	Adhesive with tack	No color change
	4	No cracking, melting or degradation	No flagging	Adhesive with tack	No color change
	5	No cracking, melting or degradation	No flagging	Adhesive with tack	No color change
2500h	1	No cracking, melting or degradation	No flagging	Adhesive with tack	No color change
	2	No cracking, melting or degradation	No flagging	Adhesive with tack	No color change
	3	No cracking, melting or degradation	No flagging	Adhesive with tack	No color change
	4	No cracking, melting or degradation	No flagging	Adhesive with tack	No color change
	5	No cracking, melting or degradation	No flagging	Adhesive with tack	No color change
3000h	1	No cracking, melting or degradation	No flagging	Adhesive with tack	No color change
	2	No cracking, melting or degradation	No flagging	Adhesive with tack	No color change
	3	No cracking, melting or degradation	No flagging	Adhesive with tack	No color change
	4	No cracking, melting or degradation	No flagging	Adhesive with tack	No color change
	5	No cracking, melting or degradation	No flagging	Adhesive with tack	No color change

Initial	

Duration	Specimen 1	Specimen 2	Specimen 3
1500h			
	Specimen 4	Specimen 5	/
			

ATR 4756 – MOC2312 Scapa 250
FORD ES-KU5T-1A303-AA

Duration	Specimen 1	Specimen 2	Specimen 3
2000h			
	Specimen 4	Specimen 5	/
			
Duration	Specimen 1	Specimen 2	Specimen 3
2500h			
	Specimen 4	Specimen 5	/
			
Duration	Specimen 1	Specimen 2	Specimen 3
3000h			
	Specimen 4	Specimen 5	/
			

250 PI2312

Duration	Specimen	Requirement a)	Requirement b)	Requirement c)	Requirement d)
1500h	1	No cracking, melting or degradation	No flagging	Adhesive with tack	No color change
	2	No cracking, melting or degradation	No flagging	Adhesive with tack	No color change
	3	No cracking, melting or degradation	No flagging	Adhesive with tack	No color change
	4	No cracking, melting or degradation	No flagging	Adhesive with tack	No color change
	5	No cracking, melting or degradation	No flagging	Adhesive with tack	No color change
2000h	1	No cracking, melting or degradation	No flagging	Adhesive with tack	No color change
	2	No cracking, melting or degradation	No flagging	Adhesive with tack	No color change
	3	No cracking, melting or degradation	No flagging	Adhesive with tack	No color change
	4	No cracking, melting or degradation	No flagging	Adhesive with tack	No color change
	5	No cracking, melting or degradation	No flagging	Adhesive with tack	No color change
2500h	1	No cracking, melting or degradation	1mm flagging	Adhesive with tack	No color change
	2	No cracking, melting or degradation	2mm flagging	Adhesive with tack	No color change
	3	No cracking, melting or degradation	2mm flagging	Adhesive with tack	No color change
	4	No cracking, melting or degradation	1mm flagging	Adhesive with tack	No color change
	5	No cracking, melting or degradation	2mm flagging	Adhesive with tack	No color change
3000h	1	No cracking, melting or degradation	No flagging	Adhesive with tack	No color change
	2	No cracking, melting or degradation	No flagging	Adhesive with tack	No color change
	3	No cracking, melting or degradation	2mm flagging	Adhesive with tack	No color change
	4	No cracking, melting or degradation	No flagging	Adhesive with tack	No color change
	5	No cracking, melting or degradation	No flagging	Adhesive with tack	No color change

Initial	

Duration	Specimen 1	Specimen 2	Specimen 3
1500h			
	Specimen 4	Specimen 5	/
			

Duration	Specimen 1	Specimen 2	Specimen 3
2000h			
	Specimen 4	Specimen 5	/
			
Duration	Specimen 1	Specimen 2	Specimen 3
2500h			
	Specimen 4	Specimen 5	/
			
Duration	Specimen 1	Specimen 2	Specimen 3
3000h			
	Specimen 4	Specimen 5	/
			

7.3.4 Thermal overload 6h at 200°C

Apparatus

Oven Climats XU250
20mm diameter mandrel
Wires Tyco Raychem ACW0219 0.35²

Sample preparation

Assemble bundles 300 mm or greater (300 to 450 mm recommended) in length of wire using two (2) 0.35 sq. mm wires; the wires are to be twisted. The insulation on the wires must have a temperature rating equal to or greater than the temperature rating of the tapes being tested. Wrap the tape to be tested around the bundle with a 50% overlap of Scapa 2630.
In addition one control sample bundle (wire without tape) shall be prepared to aid in the evaluation of wire color.
After assembly, specimens shall be allowed to stabilize for a period of 20 minutes prior to testing.

Test conditions

- Ambient climate 23°C/50%RH
- Sample length: 300 to 450mm
- Number of twisted cables 2
- Cable twist length ca. / approx 2 cm
- Overlap of tape ca. / approx 50 %
- Number of samples 3
- Conditioning Min 20min at 23°C / 50% RH
- Winding test:
    - At the end of exposure
    - Mandrel diameter: 20mm
    - Number of windings: 1

Procedure

5 specimens shall be placed in a suitable high temperature air-circulating oven capable of 8-20 air changes per hour. Specimens shall be exposed to their operable service temperature defined by Tape Class plus 50 °C for a period of 6 hours.
After exposure is complete, bend the specimens about a **20 mm** diameter mandrel. Visually inspect the specimens for any cracks, tears, melting, loss of adhesion or other forms of degradation. Measure the length of the tape ends that are flagging, if any.
Record and report any change in appearance and signs of degradation.
All specimens from this test (Post-test) shall be used to execute the material compatibility test.

7.3.4.5 Requirements

a) No cracking, melting or degradation.
b) Flagging maximum 10mm.
c) The adhesive tape should still exhibit self-adhesive properties. Reduced adhesiveness as compared to the unaged sample is permitted; full hardening or adopting a paint-like condition is, however, not permitted. The aged sample wiring harness may be sticky; however, the adhesive shall not be transferred to clean fingers.
d) Noticeable discoloration of the adhesive tape is not allowed. The color of the aged and of the unaged tape shall be documented in photographic form.

Results

250 standard

Specimen	Requirement a)	Requirement b)	Requirement c)	Requirement d)
1	No cracking, melting or degradation	0mm flagging	Sticky adhesive Non-sticky harness	No noticeable discoloration of tape
2	No cracking, melting or degradation	0mm flagging	Sticky adhesive Non-sticky harness	No noticeable discoloration of tape
3	No cracking, melting or degradation	0mm flagging	Sticky adhesive Non-sticky harness	No noticeable discoloration of tape

Requirement		Specimen 1	Specimen 2	Specimen 3
a b				
d	Unaged			

250 PI2312

Specimen	Requirement a)	Requirement b)	Requirement c)	Requirement d)
1	No cracking, melting or degradation	0mm flagging	Sticky adhesive Non-sticky harness	No noticeable discoloration of tape
2	No cracking, melting or degradation	0mm flagging	Sticky adhesive Non-sticky harness	No noticeable discoloration of tape
3	No cracking, melting or degradation	0mm flagging	Sticky adhesive Non-sticky harness	No noticeable discoloration of tape

Requirement		Specimen 1	Specimen 2	Specimen 3
a b				
d	Unaged			

7.3.5 Material compatibility

Apparatus

Climatic chamber ACS DM340
Oven Climats XU250
10mm diameter mandrel
2mm diameter mandrel
Wires Tyco Raychem ACW0219 0.35²

Test conditions

- Ambient climate 23°C/50%RH
- Sample length: 300 to 450mm
- Number of twisted cables 2
- Cable twist length ca. / approx 2 cm
- Overlap of tape ca. / approx 50 %
- Number of samples: See protocol for each ageing
- Conditioning Min 20min at 23°C / 50% RH
- Winding test:
  - At the end of each ageing and after reconditioning 4h at 23°C/50% RH
  - Mandrel diameter: 10mm and 2mm
  - Number of windings: 2

Procedure

The adhesive tape is removed from the specimen, the wires separated and a visual inspection performed. By exerting pressure with the thumb the tape is tested for stickiness. Visual alterations on the cable line or the wrapping tape shall be documented in the test report. If the wrapping tape cannot be removed without apparent damage to the cable line, this shall be documented.
One wire from the specimen is then wrapped at least two times tightly around a mandrel with diameter of 10 mm and is visually evaluated.
If requested, wrap the wires around a 2 mm mandrel and evaluate; **this test shall be for information only**.

Requirements

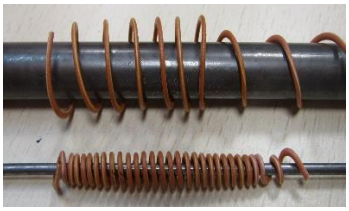
a) During the wrapping test of the wires around the mandrel these shall not exhibit any cracks, fractures or brittleness and shall not be swollen or shrunken.
b) The original color shall still be visible, identifiable and recognizable.

Results

7.3.5.1 Material compatibility after environmental cycling

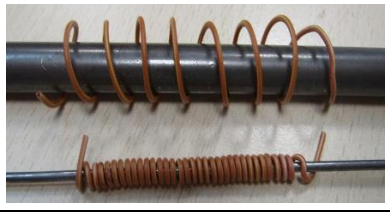
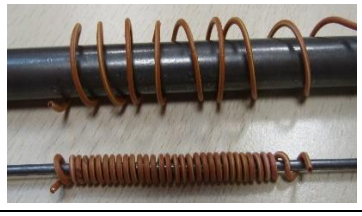
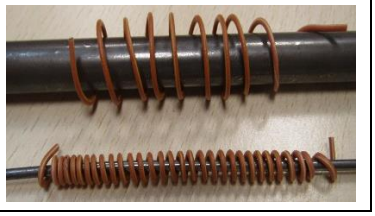
250 Standard

Specimen	Requirement a)		Requirement b)
	10mm mandrel	2mm mandrel (**for information only**)	
1	No cracking, melting or degradation…	No cracking, melting or degradation…	No noticeable change of wires vs unwrapped wires
2	No cracking, melting or degradation…	No cracking, melting or degradation…	No noticeable change of wires vs unwrapped wires
3	No cracking, melting or degradation…	No cracking, melting or degradation…	No noticeable change of wires vs unwrapped wires

Wires unaged		Wires aged without tape	
Specimen	1	2	3
Wires wrapped with tape			

250 PI2312

Specimen	Requirement a)		Requirement b)
	10mm mandrel	2mm mandrel (**for information only**)	
1	No cracking, melting or degradation…	No cracking, melting or degradation…	No noticeable change of wires vs unwrapped wires
2	No cracking, melting or degradation…	No cracking, melting or degradation…	No noticeable change of wires vs unwrapped wires
3	No cracking, melting or degradation…	No cracking, melting or degradation…	No noticeable change of wires vs unwrapped wires

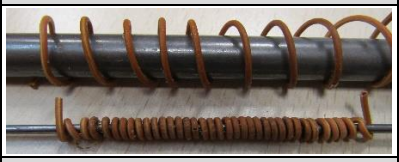
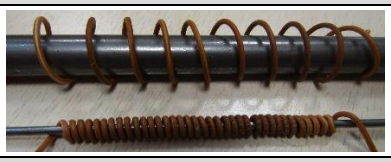
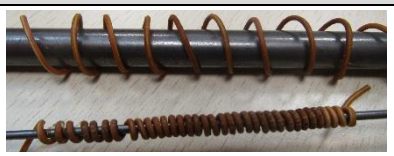
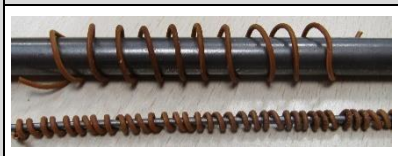
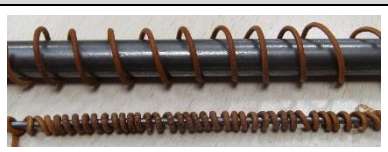
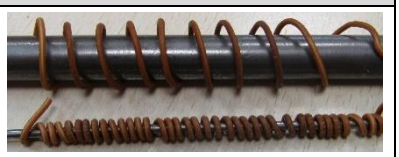
Wires unaged		Wires aged without tape	
Specimen	1	2	3
Wires wrapped with tape			

7.3.5.2 Material compatibility after heat ageing 3000h at 150°C

250 STANDARD

Duration	Specimen	Requirement a)		Requirement b)
		10mm mandrel	2mm mandrel (**for information only**)	
1500h	1	On the 5 samples, no cracking, melting or degradation…	On the 5 samples, no cracking, melting or degradation…	On the 5 samples, no noticeable change of wires vs wire aged without tape
	2			
	3			
	4			
	5			
2000h	1	On the 5 samples, no cracking, melting or degradation…	1 crack of insulation	On the 5 samples, no noticeable change of wires vs wire aged without tape
	2		No cracking, melting or degradation…	
	3		1 crack of insulation	
	4		2 cracks of insulation	
	5		Several cracks of insulation	
2500h	1	On the 5 samples, no cracking, melting or degradation…	On the 5 samples, several cracks of insulation	On the 5 samples, no noticeable change of wires vs wire aged without tape
	2			
	3			
	4			
	5			
3000h	1	On the 5 samples, no cracking, melting or degradation…	1 crack of insulation	On the 5 samples, no noticeable change of wires vs wire aged without tape
	2		2 cracks of insulation	
	3		1 crack of insulation	
	4		Several cracks of insulation	
	5			

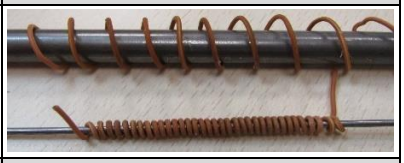
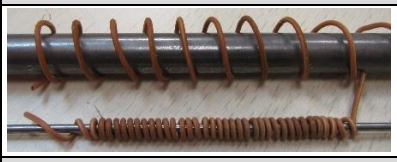
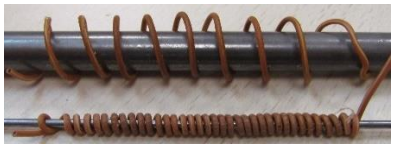
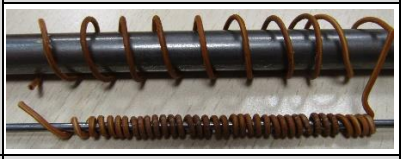
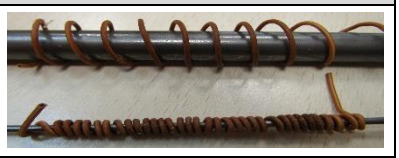
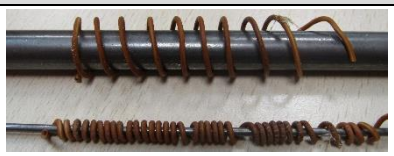
Initial	

Duration	Unwrapped wires aged	Wrapped wires Specimen 1	Wrapped wires Specimen 2
1500h			
	Wrapped wires Specimen 3	Wrapped wires Specimen 4	Wrapped wires Specimen 5
			
Duration	Unwrapped wires aged	Wrapped wires Specimen 1	Wrapped wires Specimen 2
2000h			
	Wrapped wires Specimen 3	Wrapped wires Specimen 4	Wrapped wires Specimen 5
			
Duration	Unwrapped wires aged	Wrapped wires Specimen 1	Wrapped wires Specimen 2
2500h			
	Wrapped wires Specimen 3	Wrapped wires Specimen 4	Wrapped wires Specimen 5
			
Duration	Unwrapped wires aged	Wrapped wires Specimen 1	Wrapped wires Specimen 2
3000h			
	Wrapped wires Specimen 3	Wrapped wires Specimen 4	Wrapped wires Specimen 5
			

250 PI2312

Duration	Specimen	Requirement a)		Requirement b)
		10mm mandrel	2mm mandrel (**for information only**)	
1500h	1	On the 5 samples, No cracking, melting or degradation…	On 4 samples, No cracking, melting or degradation…	On the 5 samples, No noticeable change of wires vs wire aged without tape
	2			
	3			
	4			
	5		On 1 sample, 1 crack of insulation	
2000h	1	On the 5 samples, No cracking, melting or degradation…	No cracking, melting or degradation…	On the 5 samples, No noticeable change of wires vs wire aged without tape
	2			
	3			
	4			
	5		1 crack of insulation	
2500h	1	On the 5 samples, no cracking, melting or degradation…	On the 5 samples, several cracks of insulation	On the 5 samples, no noticeable change of wires vs wire aged without tape
	2			
	3			
	4			
	5			
3000h	1	On the 5 samples, no cracking, melting or degradation…	On the 5 samples, several cracks of insulation	On the 5 samples, no noticeable change of wires vs wire aged without tape
	2			
	3			
	4			
	5			

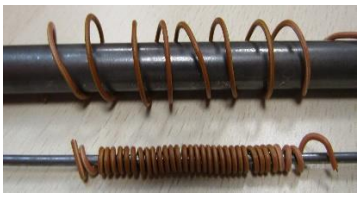
Initial	

Duration	Unwrapped wires aged	Wrapped wires Specimen 1	Wrapped wires Specimen 2
1500h			
	Wrapped wires Specimen 3	Wrapped wires Specimen 4	Wrapped wires Specimen 5
			
Duration	Unwrapped wires aged	Wrapped wires Specimen 1	Wrapped wires Specimen 2
2000h			
	Wrapped wires Specimen 3	Wrapped wires Specimen 4	Wrapped wires Specimen 5
			
Duration	Unwrapped wires aged	Wrapped wires Specimen 1	Wrapped wires Specimen 2
2500h			
	Wrapped wires Specimen 3	Wrapped wires Specimen 4	Wrapped wires Specimen 5
			
Duration	Unwrapped wires aged	Wrapped wires Specimen 1	Wrapped wires Specimen 2
3000h			
	Wrapped wires Specimen 3	Wrapped wires Specimen 4	Wrapped wires Specimen 5
			

7.3.5.3 Material compatibility after thermal overload 6H at 200°C

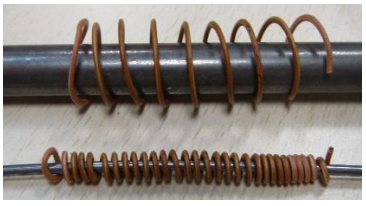
250 Standard

Specimen	Requirement a)		Requirement b)
	10mm mandrel	2mm mandrel (**for information only**)	
1	No cracking, melting or degradation…	No cracking, melting or degradation…	No noticeable change of wires vs unwrapped wires
2	No cracking, melting or degradation…	No cracking, melting or degradation…	No noticeable change of wires vs unwrapped wires
3	No cracking, melting or degradation…	No cracking, melting or degradation…	No noticeable change of wires vs unwrapped wires

Wires unaged		Wires aged without tape	
Specimen	1	2	3
Wires wrapped with tape			

250 PI2312

Specimen	Requirement a)		Requirement b)
	10mm mandrel	2mm mandrel (**for information only**)	
1	No cracking, melting or degradation…	No cracking, melting or degradation…	No noticeable change of wires vs unwrapped wires
2	No cracking, melting or degradation…	No cracking, melting or degradation…	No noticeable change of wires vs unwrapped wires
3	No cracking, melting or degradation…	No cracking, melting or degradation…	No noticeable change of wires vs unwrapped wires

Wires unaged		Wires aged without tape	
Specimen	1	2	3
Wires wrapped with tape			

7.4 Fluid resistance

Apparatus

Closed and ventilated equipment
Oven Climats XU175


Sample preparation

Assemble bundles 300 mm or greater (300 to 450 mm recommended) in length of wire using two (2) 0.35 sq. mm wires; the wires are to be twisted. The insulation on the wires must have a temperature rating equal to or greater than the temperature rating of the tapes being tested. Wrap the tape to be tested around the bundle with a 50% overlap of Scapa 2630.

After assembly, specimens shall be allowed to stabilize for a period of 20 minutes prior to testing.

Test conditions

- Ambient climate 23°C/50%RH
- Sample length: 300 mm
- Number of twisted cables 2
- Overlap of tape ca. / approx 50 %
- *Number of samples: 1 by fluid (instead of 3, due to the wires quantity available)*
- Conditioning before immersion Min 20min at 23°C / 50% RH
- Fluid immersion time: 5min
- Fluid immersion temperature: 23°C or 90°C
- Winding test:
  - After ageing periods of 72h (instead of 24, 48 and 72h, *due to the wires quantity available*).
  - Mandrel diameter: 40mm
  - Number of windings: 1

Procedure

Prepare samples and conduct the tests in accordance with SAE J2192, sections 7.7.1 to 7.7.3, Fluids Resistance. Use table 4 below for list of fluids and temperatures the test is to be run against. In the case of battery acid with aluminium covered tapes, dip the sample in the acid for one (1) second. **Take precautions to ensure that at least 10 mm from each end of the sample is not exposed to the fluid.**
Visually inspect each specimen for any sign of degradation *after aging periods of 72h (instead of 24, 48 and 72 hours)*. Bend each specimen about a 40 mm diameter mandrel.
Visually inspect the specimens for any cracks, tears, melting, loss of adhesion or other forms of degradation. Measure the length of the tape ends that are flagging, if any.
Record and report any change in appearance and signs of degradation.

Fluid	Immersion time (min)	Fluid temperature (°C)	Fluid	Immersion time	Fluid temperature
Battery acid (H2SO4)	5	23 ± 3	E85 Ethanol	5	23 ± 3
Windshield washer		23 ± 3	Transmission fluid		90 ± 3
Engine coolant		90 ± 3	Power steering fluid		90 ± 3
Brake fluid		23 ± 3	Engine oil		90 ± 3
Gasoline (SP95 E10)		23 ± 3	Engine cleaner		23 ± 3
Diesel		23 ± 3	Salt spray (5% NaCl)		23 ± 3

Requirements

a) No cracking, melting or degradation.
b) Flagging maximum 10mm.
c) The adhesive tape should still exhibit self-adhesive properties. Reduced adhesiveness as compared to the unaged sample is permitted; full hardening or adopting a paint-like condition is, however, not permitted. The aged sample wiring harness may be sticky; however, the adhesive shall not be transferred to clean fingers.
d) Noticeable discoloration of the adhesive tape is not allowed. The color of the aged and of the unaged tape shall be documented in photographic form.

Results

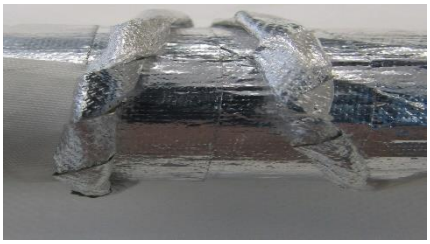
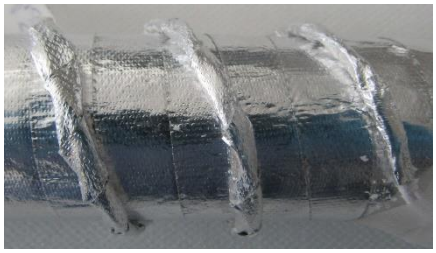
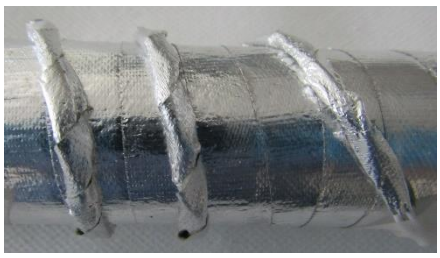
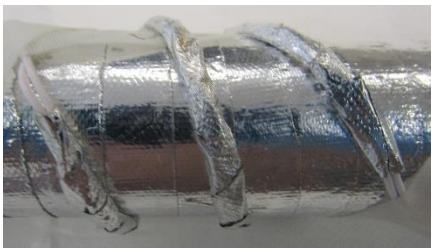
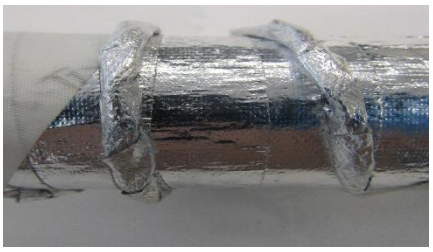
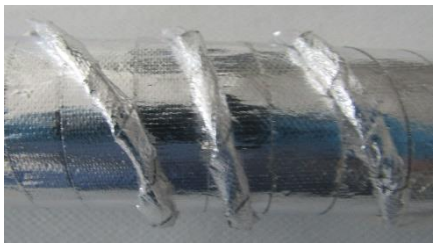
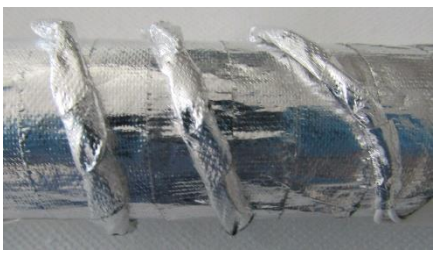
250 Standard

Fluid	Requirement a	Requirement b	Requirement c	Requirement d
Battery acid	No cracking or other defects	No flagging	Pass all the requirements	No discoloration of tape, but becomes matte
Windshield washer	No cracking or other defects	No flagging	Pass all the requirements	No discoloration of tape
Engine coolant	No cracking or other defects	No flagging	Pass all the requirements	No discoloration of tape
Brake fluid	No cracking or other defects	No flagging	Pass all the requirements	No discoloration of tape
Gasoline (SP 95 E10)	No cracking or other defects	No flagging	Pass all the requirements	No discoloration of tape
Diesel	No cracking or other defects	No flagging	Pass all the requirements	No discoloration of tape
E85 Ethanol	No cracking or other defects	No flagging	Pass all the requirements	No discoloration of tape
Transmission fluid	No cracking or other defects	No flagging	Pass all the requirements	No discoloration of tape
Power steering fluid	No cracking or other defects	No flagging	Pass all the requirements	No discoloration of tape
Engine oil	No cracking or other defects	No flagging	Pass all the requirements	No discoloration of tape
Engine cleaner	No cracking or other defects	No flagging	Pass all the requirements	No discoloration of tape
Salt spray (NaCl 5%)	No cracking or other defects	No flagging	Pass all the requirements	No discoloration of tape

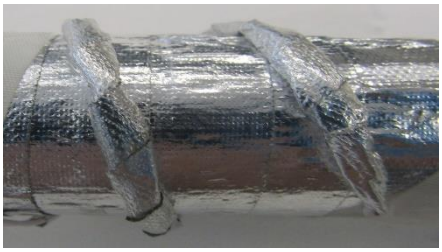
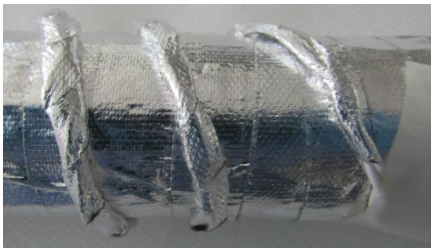
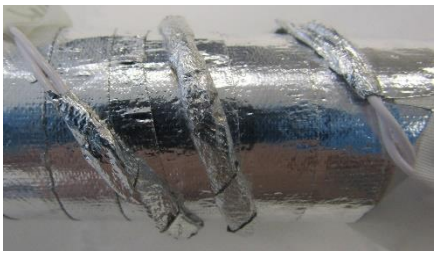
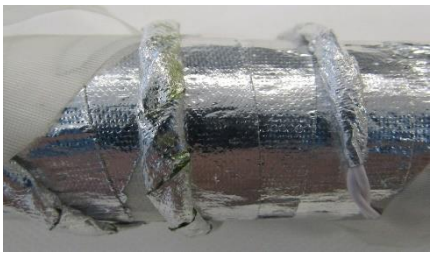
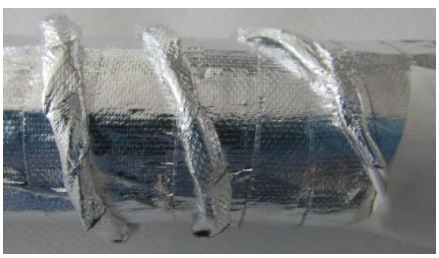
250 PI2312

Fluid	Requirement a	Requirement b	Requirement c	Requirement d
Battery acid	No cracking or other defects	No flagging	Pass all the requirements	No discoloration of tape, but becomes matte
Windshield washer	No cracking or other defects	No flagging	Pass all the requirements	No discoloration of tape
Engine coolant	No cracking or other defects	No flagging	Pass all the requirements	No discoloration of tape
Brake fluid	No cracking or other defects	No flagging	Pass all the requirements	No discoloration of tape
Gasoline (SP 95 E10)	No cracking or other defects	No flagging	Pass all the requirements	No discoloration of tape
Diesel	No cracking or other defects	No flagging	Pass all the requirements	No discoloration of tape
E85 Ethanol	No cracking or other defects	No flagging	Pass all the requirements	No discoloration of tape
Transmission fluid	No cracking or other defects	No flagging	Pass all the requirements	No discoloration of tape
Power steering fluid	No cracking or other defects	No flagging	Pass all the requirements	No discoloration of tape
Engine oil	No cracking or other defects	No flagging	Pass all the requirements	No discoloration of tape
Engine cleaner	No cracking or other defects	No flagging	Pass all the requirements	No discoloration of tape
Salt spray (NaCl 5%)	No cracking or other defects	No flagging	Pass all the requirements	No discoloration of tape

250 Standard

Results		
Initial		
		
Engine oil	**Salt spray**	**E85**
		
SP95	**Diesel**	**Power steering fluid**
		
Transmission fluid	**Engine coolant**	**Battery acid**
		
Brake fluid	**Engine cleaner**	**Windshield washer**
		

250 PI2312

Results		
Initial		
		
Engine oil	**Salt spray**	**E85**
		
SP95	**Diesel**	**Power steering fluid**
		
Transmission fluid	**Engine coolant**	**Battery acid**
		
Brake fluid	**Engine cleaner**	**Windshield washer**
		

7.5 Cold flexibility 4h at -40°C

Apparatus

Climatic chamber ACS DM340
Wires type a Coroplast FEP FLR9Y white 0,35²

Sample preparation

Assemble bundles 300 mm or greater (300 to 450 mm recommended) in length of wire using two (2) 0.35 sq. mm wires; the wires are to be twisted. The insulation on the wires must have a temperature rating equal to or greater than the temperature rating of the tapes being tested. Wrap the tape to be tested around the bundle with a 50% overlap of Scapa 2630.
After assembly, specimens shall be allowed to stabilize for a period of 20 minutes prior to testing.

Test conditions

- Ambient climate 23°C/50%RH
- Sample length: 300 to 450mm
- Number of twisted cables 2
- Cable twist length ca. / approx 2 cm
- Overlap of tape ca. / approx 50 %
- Number of samples 3
- Conditioning Min 20min at 23°C / 50% RH
- Winding test:
    - Test at -40°C
    - Mandrel diameter: 20mm
    - Weight: 0.5kg
    - Number of windings min 2

Procedure

Fasten the wrapped wiring harnesses to a rotatable mandrel with a diameter of 20 mm. Load the free end with a weight of 0,5 kg.
Age the specimens for 4 h at -40°C in a cold chamber. Then, wrap the wiring harness around the mandrel at least twice (in the cold chamber).

Requirements

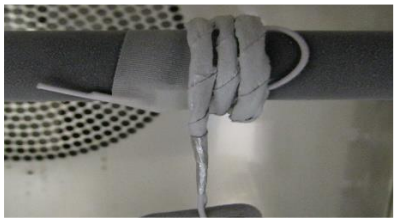
After exposure and wrapping is complete, visually inspect the specimen for any cracks, tears, loss of adhesion or other forms of degradation and measure the length of the tape ends that are flagging, if any.
Record and report any change in appearance and signs of degradation.

Result

250 Standard

1	2	3
		
Comply	Comply	Comply

250 PI2312

1	2	3
		
Comply	Comply	Comply

7.6 Fogging

Apparatus

0011 Fog – Test hart scientific VA-04

Procedure

Determination of the Fogging Number shall be performed according to SAE J1756 Test Procedure. The testing exposure shall be 3 hours at 100 °C. For this procedure, aluminium foil shall be used as the testing substrate for all adhesive tapes.

Requirement

Fog number >20

Result

Test made by Scapa Italia
Post test conditioning period 1h

250 Standard

Sample	1	2	3	4
Fogging (%)	100	100	100	100
Average fogging (%)	**100**			

250 PI2312

Sample	1	2	3	4
Fogging (%)	98	99	99	99
Average fogging (%)	**99**			

7.7 Flammability

Apparatus

Combustion chamber EquipLabo with Scapa horizontal flame equipment
Stopwatch RSPRO n°1443


Sample preparation

Test based on ISO 3795 (horizontal flammability)
Cable harness with 7 cables 1mm² and 50% overlap (Wrap the tape to be tested around the bundle with a 50% overlap).

Test conditions

According ISO 3795

Evaluation

Burning rate = D/T x 60 (mm/min
D = Burning distance measured after the first reference mark.
T = burning time from the first reference mark.

Requirement

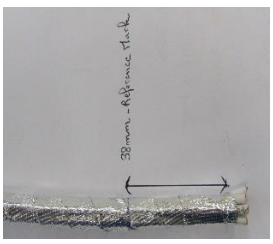
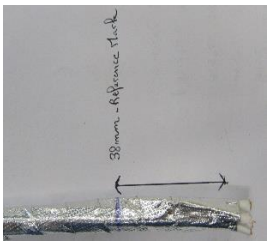
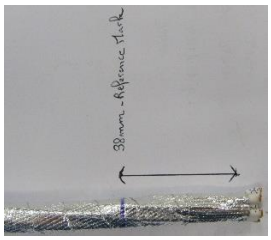
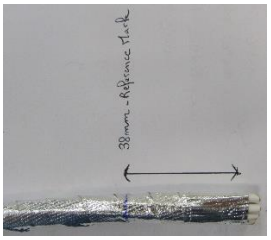
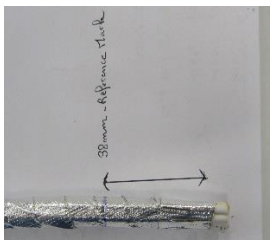
Maximum burn rate of 100mm/min

Result

250 Standard

Flame goes out as soon as burner is removed.

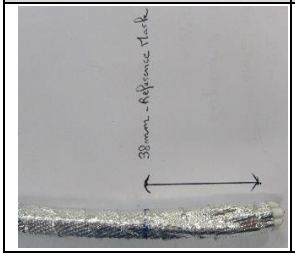
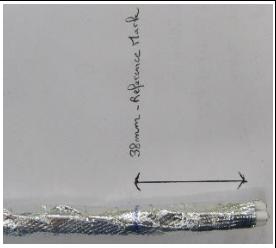
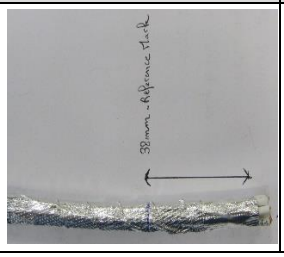
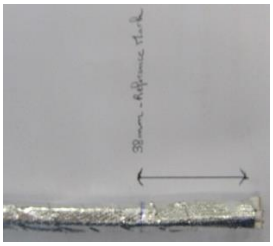
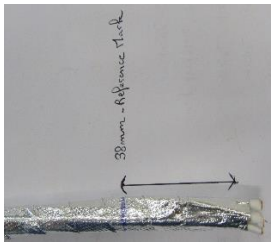
Specimen	Burn distance (mm)	Burn time (min)	Burn rate (mm/min)	Burn rate max (mm/min)	Pass	Fail
1	0	0	0	0	X	
2	0	0	0		X	
3	0	0	0		X	
4	0	0	0		X	
5	0	0	0		X	

Specimen 1	Specimen 2	Specimen 3	Specimen 4	Specimen 5
				

250 PI2312

Flame goes out as soon as burner is removed.

Specimen	Burn distance (mm)	Burn time (min)	Burn rate (mm/min)	Burn rate max (mm/min)	Pass	Fail
1	0	0	0	0	X	
2	0	0	0		X	
3	0	0	0		X	
4	0	0	0		X	
5	0	0	0		X	

Specimen 1	Specimen 2	Specimen 3	Specimen 4	Specimen 5
				

7.8 Odor rating

Apparatus

Oven Heareus UT6060
Glass container (instead of metallic cans)


Procedure

Test based on SAE J1351
Evaluation after dry exposure.

Test conditions

- Sample area: 250cm²
- Conditioning prior test: 2h at 23°C / 50% RH
- Ageing temperature: 70°C
- Ageing time: 24h
- Odor panel: 3

Evaluation

Odor scale evaluation

- Rating 1: No noticeable odor
- Rating 2: Slight, but noticeable odor
- Rating 3: Definite odor, but not strong enough to be offensive
- Rating 4: Strong offensive odor
- Rating 5: Very strong offensive odor

Note that the scale is arbitrary

Requirement

Passing the odor test for the applicable market is mandatory for tapes intended to be used in the vehicle interior. For tapes intended for use only in the vehicle exterior, it is not mandatory, nor is it necessary for the odor test to be performed.

Odor rating ≤ 2

Result

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	Tester	Scale Dry	Scale Mean	Pass	Fail
250 Standard	1	2	2	X	
	2	2			
	3	2			
	Tester	Scale Dry	Scale Mean	Pass	Fail
250 PI2312	1	2	2	X	
	2	2			
	3	2			

7.9 N/A reserved

7.10 Noise dampening

Apparatus

Sample preparation

Sample length (50 ± 5) mm
Sample width (19 ± 1) mm

Procedure

The noise is measured by a microphone positioned 50mm over the impact location. The noise is measured in the form of the sound pressure level (*L*sp) with frequency evaluation A and time evaluation S. A single layer of the adhesive tape is applied to the steel bar in the area of the impact location over a length of 5 cm in longitudinal direction. Measured is the difference between the noise of the bar wrapped with adhesive tape and the unwrapped bar. The measuring unit is dB(A).
The measurement is performed ten times at the same location of the specimen. If a trend towards lower silencing values can be discerned, for example by compressing the specimen, this shall be noted in the test report.

Classification

Requirement [dB(A)]	Class
0 to ≤ 2	**0**: No noise dampening
> 2 to ≤ 5	**1**: Little noise dampening
> 5 to ≤ 10	**2**: Medium noise dampening
> 10 to ≤ 15	**3**: High noise dampening
> 15	**4**: Very high noise dampening
N/A	**N**: Not tested

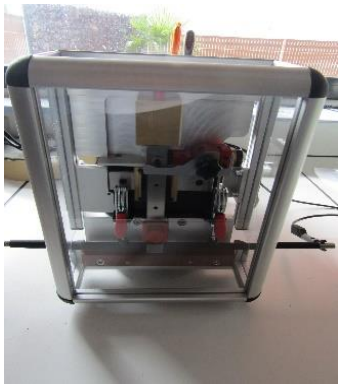
Result

Measurement	Without tape	With 250 Standard	With 250 PI2312
	Max acoustic [dB(A)]		
1	84.4	80.4	79.4
2	84.4	82.6	81.4
3	84.1	82.6	82.3
4	84.5	82.2	82.2
5	84.5	82.3	82.4
6	84.7	82.6	82.0
7	84.1	82.7	81.8
8	84.3	82.4	82.1
9	84.2	82.5	82.6
10	84.0	82.1	82.6
Mean	**84.3**	**82.2**	**81.9**
Attenuation		**2.1dB**	**2.4dB**
Class		**1**	**1**

7.11 Abrasion resistance

Apparatus

TVAB5420 abrasion tester / 5mm mandrel / Stahlbecker 0.45mm needle



Test conditions

- Ambient temperature (23 ± 1) °C
- Number of samples 5 Rolls
- Number of measurements: 2 per roll
- Sample length: 100 mm longitudinally glued in a single layer
- Frequency of double strokes (50 – 60) min-1
- Length of abrasion (15,5 ± 1) mm
- Needle diameter (0,45 ± 0,01) mm
- Test force: 7 N
- Test mandrel: 5 mm Steel

Evaluation

Number of cycles (double strokes) and classification

Classification

Number of cycles	Class	Number of cycles	Class
< 100	**0**: No wear protection	5000 to 14999	**4**: Very high wear protection
100 to 499	**1**: Little wear protection	15000 to 29999	**5**: Ultra high wear protection
500 to 999	**2**: Medium wear protection	> 29999	**6**: Super high wear protection
1000 to 4999	**3**: High wear protection	/	**N**: Not tested

Result

Number of cycles								Class
Roll 1	Roll 2	Roll 3	Roll 4	Roll 5	*Min*	*Max*	**Mean**	
250 standard								
<20								**0**
250 PI2312								
<20								**0**

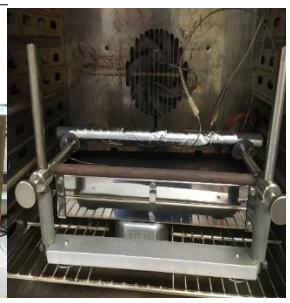
the aluminum tape being an electrical conductor, it is not possible to carry out the test according to its operating mode, the number of cycles is therefore approximately evaluated visually.

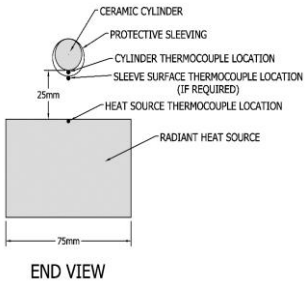
7.12 Thermal effectiveness

Apparatus

Scapa equipment 1000345

- Hot box: Metal box 33 x 40 x 40cm
- Thermocouples: Type K Watlow
- Heat source: Raymax 1330 Watlow
- Temperature controller/recorder: Watlow F4T
- Cylinder: Silicon carbide mandrel rod, 16 mm OD x 320 mm long Morgan Technical Ceramics R00RSC 160 000 03200





END VIEW

Procedure

SAE J2302

Test duration 30 min from steady state (Steady-state is defined as three consecutive readings within ±2 °C of the set temperature. The starting point for determining the initial reaching of steady-state is when the continuous readout (temperature recorder) shows the first indication of the temperature to be measured.

- Test temperatures *Only 482 °C* ***±2°C***

- Test height 25 mm

- Overlap of tape 50 %

- Covering of the cylinder ≥ 28 cm

- Number of measurements : 1 by temperature for cylinder without tape / *1 by temperature with tape (instead of 3)*

Results

Temperature (°C)	Sample	Average of the cylinders surface temperature WITHOUT TAPE (BLUC)	Average of the cylinders surface temperature WITH TAPE (SSCf)	Thermal effectiveness (BLUC – SSCf)
121°C	Not tested			
260°C	Not tested			
482°C	250 standard	217.1	123.8	**93.3**
	250 PI2312	217.1	127.8	**89.3**

Test made by Edag laboratory for the data given for the Ford approval

Test at 482°C

REFERENCE (without tape)			Average cylinder t°
Time(min)	Heat source t°(C)	Cylinder t°(°C)	
3	480.4	141.9	BLUC 217.1°C
6	481.4	173.4	
9	481.6	195.3	
12	482.1	210.9	
15	482.5	222.3	
18	482.3	232.6	
21	482.0	239.6	
24	482.4	246.3	
27	482.0	252.2	
30	482.2	256.3	

250 STANDARD			Average cylinder t°	250 PI2312		Average cylinder t°
Time(min)	Heat source t°(°C)	Cylinder t°(°C)		Heat source t°(C)	Cylinder t°(°C)	
3	480.2	56.6	SSCf 123.8°C	480.1	57.9	SSCf 127.8°C
6	481.5	74.9		481.2	77.6	
9	481.8	92.3		482.0	96.3	
12	482.0	108.5		482.2	111.9	
15	481.8	122.3		482.2	127.5	
18	481.9	135.3		482.0	140.0	
21	482.1	146.8		481.9	152.1	
24	482.1	157.6		481.7	161.8	
27	481.9	167.6		482.4	172.4	
30	482.2	176.2		482.0	180.4	

7.13 Dielectric performance

N/A – Tape not used for splice

8.1 Color

Evaluation

Visual according DIN IEC 60304

Requirement

Silver

Result

Visual: Silver

End of test report