Testing standards for arc rated garments – Part 2

Information from JAS Consulting

Following the first article on electrical arc flash safety (*Energize* October 2009), South Africans are accepting electrical arc flash hazards as an everyday reality in the workplace. Electrical workers discuss the topic with keen interest and display an admirable understanding of the phenomenon.

This understanding is driven by papers, training courses, the internet, engineering magazines and most often sales and marketing teams. However, it is still common for large electrical concerns issue a product based tender rather than sound performance based specification.

Selecting arc rated protective equipment and clothing requires a sound understanding of test methods and the associated acceptance criterion. This series of articles will introduce the standardised requirements based on SANS 724: *Personal protective equipment and protective clothing against the thermal hazards of an electric arc* by focussing on two very important fabric specifications.

Terminology

Terminology pertaining to arc rated personal protective clothing (PPC) is simple, but often misused. Fabric in a single layer or multiple layers forms material. Material is used to construct garments. Garments are defined as single items of clothing such as trousers, shirts, jackets and one piece overalls or boiler suits. An assembly of garments will constitute PPC.

Introducing ASTM F1506 and IEC 61482-2

The foundation to material specification in SANS 724 (Section 6.2) is embedded in two "textile" standards. These are the *ASTM F1506: Standard performance specification for flame resistant textile materials for wearing apparel for use by electrical workers exposed to momentary electric arc and related thermal hazards,* and *IEC 61482-2, Live working – Protective clothing against the thermal hazards of an electric arc – Part 2:*

Requirements

SANS 724 does not stipulate test requirements for materials aimed at achieving an arc rating. This is due to the fact that a test method is not a pass/fail criterion. However, the ASTM F1506 and IEC 61482-2 does define acceptance criterion of arc rated materials. It is for this reason that the arc test methods are not referenced in SANS 724 but rather the ASTM F1506 and IEC 61482-2 standards are referenced. The arc test is merely one in a suite of test requirements in these standards. Tables 1 and 2 are provided to explain the material requirements of SANS 724.

Test requirements	IEC 61482-2	ASTM F1506
Limited Flame Spread Index	Tested in accordance with ISO 15025 Procedure A and classified as per ISO 14116 Single Layer: Index 3 / Multilayered Outer Layers: Index 3 / Multilayered Inner Layers: Index 1	
Dimensional change	ISO 5077 ±3%	AATCC Method 135 (Washing) AATCC Method 158 (Dry Cleaning) 3%
Tear resistance	ISO 13937-2 150 – 220 g/m²: 10N; > 220 g/m²: 15N	Test Method D1424 3.0 - 5.9 oz/yd²: 11N; 6.0 – 8.4 oz/yd²: 18N; > 8.5 oz/yd²: 22N
Tensile Strength	ISO 13934-1 150 – 220 g/m²: 250N; > 220 g/m²: 400N	Test Method D 5034 3.0 - 5.9 oz/yd²: 134N; 6.0 – 8.4 oz/yd²: 179N; > 8.5 oz/yd²: 223N
Seam Slippage		Test Method D434 3.0 - 5.9 oz/yd²: 6mm at 134N; 6.0 – 8.4 oz/yd²: 6mm at 179N; > 8.5 oz/yd²: 6mm at 223N
Colourfastness		
Laundering Shade Change (min)		AATCC Method 61, IIA Class 3
Dry-Cleaning Shade Change (min)		AATCC Method 132 Class 3
Flammability		
Initial Flammability		Test Method D 6413 Char Length (max) 152mm After flame (max) 2 seconds
Flammability after		Test Method D 6413 Char Length (max) 152mm After flame (max) 2 seconds Laundry – AATCC Method 135 – 25 cycles Dry Cleaning – AATCC Method 158 – 25 cycles
Arc Test	IEC 61482-1-1 or IEC 61482-1-2	ASTM F1959 Maximum after flame of 5 seconds

Table 1: Mechanical requirements for woven fabrics.

Understanding the tables

Both IEC and ASTM require a vertical flame test. In the case of the ASTM test method D6413, shown in Fig. 1, the material shall be pre-laundered and tested. After exposure to a flame, the char length shall not exceed 152 mm and the after-flame shall not continue for more than two seconds.The fabric shall then be laundered or dry cleaned for 25 cycles and thereafter the test shall be repeated and the same criterion achieved. After the 25 cycle laundering the specimen shall not shrink more than 5% in the case of knit fabrics.

Bursting strength, tear resistance and breaking load/tensile strength are common test criterions between the IEC and ASTM standards. It would make sense that all test criterions above are met before performing the arc test since the arc test is the most expensive. It must be noted that the requirements in Table 1 or 2 need not be met in any particular order.Therefore, a test house performing the arc test will typically not request proof of the above tests being passed before performing an arc test.

If a garment manufacturer or a clothing

Test requirements	IEC 61482-2	ASTM F1506
Limited Flame Spread Index	Tested in accordance with ISO 15025 Procedure A and classified as per ISO 14116 Single Layer: Index 3 / Multilayered Outer Layers: Index 3 / Multilayered Inner Layers: Index 1	
Bursting strength	ISO 13938-1 200kPa	Test Method D 3786 100g/m² : Report only / 101g/m² – 275g/m² : 275N / > 276g/m² : 345N
Colorfastness	Class 3	
Dimension change	ISO 5077 ±5%	AATCC Method 135 – Washing AATCC Method 158 – Dry Cleaning Max 3%
Flammability		
Initial Flammability		Test Method D 6413 Char Length (max) 152mm After flame (max) 2 seconds
Flammability after		Test Method D 6413 Char Length (max) 152mm After flame (max) 2 seconds Laundry – AATCC Method 135 – 25 cycles Dry Cleaning – AATCC Method 158 – 25 cycles
Arc Test	IEC 61482-1-1 or IEC 61482-1-2	ASTM F1959 Maximum after flame of 5 seconds

Table 2: Mechanical requirements for knit fabrics.

manufacturer seeks compliance with SANS 724, the applicable requirements Table 1 or 2 shall first be proven.

Conclusion

The contents of SANS 724 do not directly reference the popular arc test standards viz. IEC 61482-1-1, IEC 61482-1-2 or ASTM F1959. Material which meets the requirements of SANS 724 shall comply with either IEC 61482-2 or ASTM F1506. The arc test forms one of the many other material tests which are discussed in Tables 1 and 2 of this paper. In the next paper in the series of electrical arc flash Safety, the arc test methods IEC 61482-1-1, IEC 61482-1-2 and ASTM F1959 will be discussed together with the requirements for arc rated clothing.

Fig. 1: The ASTM D6413 vertical flame test.

References

[1] Electrical Arc Flash and Workplace Safety Training Course, Hugh Hoagland and Zarheer Jooma, www.e-hazard.com/, 2009

[2] SANS 724:2010 -Personal protective equipment, protective clothing against the thermal hazards of an electric arc

[3] IEC 61482-2 Edition 1.0 2009-04 Live working – Protective clothing against the thermal hazards of an electric arc – Part 2: Requirements.

[4] ASTM F1506 – 08 Standard performance specification for flame resistant textile materials for wearing apparel for use by electrical workers exposed to momentary electric arc and related thermal hazards

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