CSA GROUP RESEARCH

Analysis of the Standard for Evaluation of Properties of Polymeric Materials

Executive Summary

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Executive Summary

Objective

The objective of this project is to propose a plan for updating and providing ongoing support for CSA C22.2 No. 0.17, *Evaluation of properties of polymeric materials.* This project explores the industry and market trends for polymeric materials, the current state of international standards for these materials and the electrical products that use them. With this information, a potential strategy for the future direction of C22.2 No. 0.17 can be identified to ensure its relevancy is maintained with technology advancements of polymerics and the continuously evolving usage of these materials in electrical equipment.

Background

C22.2 No. 0.17, *Evaluation of properties of polymeric materials* is a horizontal standard in the Canadian Electrical Safety System that is used to ensure that there are consistently high safety requirements across all of the standards for electrical safety of products. Based on the technological advancement of polymeric materials, the expanding usage of these materials in electrical products, and the evolution of standards for evaluating polymeric materials, a plan is needed to ensure that this standard remains current.

There is currently an abundance of information available about combining polymeric materials with electrical applications. Users want products, devices, and equipment that are smaller, smarter, and stronger. At the same time, regulators are establishing more stringent safety and environmental rules for these materials and components.

The properties of traditional plastics and how they are manufactured are well-established and understood. Increasingly though, composite polymeric materials engineered for properties such as strength, heat resistance, and improved manufacturability are being used. While they can improve performance, their complexity requires more extensive analysis to understand the interactions in the final material compounds.

Additive manufacturing (3D printing)

Additive manufacturing is creating opportunities for design innovation, including electronic components and printed circuit boards which use conductive polymeric materials. Though application in the electrical sector is still limited, in the future mass production of electrical components such as connectors, switches, and capacitive solutions could begin. Due to the decentralized nature of 3D printing, some production could possibly shift to multiple machines in distributed networks and even to private (home-based) operations.

There are currently 55 international standards that apply to the testing of mechanical properties of polymers and composites. Though not all of these standards are applicable to additive manufacturing, most of these standards can be applied to testing parts produced by additive manufacturing. Because many of the existing standards to validate polymeric performance continue to be applicable, the test methods in CSA C22.2 No. 0.17 will remain largely applicable; however, new test methods may need to be investigated.

Environmental awareness

Environmental awareness is an area that also requires consideration, particularly as it pertains to *sustainability* and *resilience*. Sustainability focuses on reducing environmental impact throughout the product life cycle, while resilience relates to the ability for normal service to be resumed or seamlessly maintained in the event of a catastrophe.

Though currently the percentage of the overall plastics production is small, bioplastics production is set to increase dramatically in the coming years. Those materials that are bio-based but non-biodegradable will likely become more prevalent and will require monitoring and consideration in future editions of CSA C22.2 No. 0.17. Increased production of bioplastics may lead to more need for disposal/recycling solutions and possibly an increase in fossil fuel consumption.

Low voltage DC power systems

The growth of solar photovoltaics (PV), LED lighting, and the overall trend towards energy efficiency and sustainability has led to an increased demand for low voltage direct current (LVDC). The concern about environmental impacts has also led to the transition of some applications, buildings and transmission networks from AC- to DC-based operations. Though LVDC is still relatively new, work should be done to assess safety, application, and how this technology could impact standards such as CSA C22.2 No. 0.17.

Power over Ethernet (PoE)

Power over Ethernet (PoE) has become increasingly common and is part of the general trend towards digitization, driving the growth of building automation and SMART systems. PoE combines power distribution with data communication and opens the possibility of increased power transmission applications. Because the cables are bundled together and installed in a tight space, cable heating can become a problem. New PoE installation requirements were added to the 2018 *Canadian Electrical Code* and additional consideration may be needed for the polymeric materials used in insulation and a number of interconnected parts.

Conclusions

Currently, there is no singular international standard available that meets the scope of CSA C22.2 No. 0.17 and it is recommended that it be updated.

New technologies in the areas of materials (bioplastics) and production methods (additive manufacturing) are expected to influence the future content of standards such as CSA C22.2 No. 0.17. Indications at this time suggest that the current test methods will remain relevant to the base materials, but further tests may need to be added for other characteristics.

Monitoring emerging DC power systems is recommended to assess safety, application, and how this may impact standards such as CSA C22.2 No. 0.17.

It is recommended that ASTM standards continue to be used as the primary reference for the requirements and methodology for evaluation of polymerics, with IEC standards referenced to maintain consistency with adoption of IEC standards.

Additional areas for consideration include

a) water absorption of synthetic polymeric materials (bioplastics);

b) resistance of plastics to reagents;

c) strength of plastics and adhesives;

d) hazardous chemical content of plastics;

e) thermal properties of materials; and

f) resistance to weathering.

The technological advancements in both testing and materials provides for an opportunity to expand the scope of the standard. This should be carried out with international harmonization in mind, even though CSA C22.2 No. 0.17 is embedded in the *Canadian Electrical Code*.