# Uniaxial tensile mechanical properties of ECTFE (ethylene-chlorotrifluoroethylene) foils

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## Abstract

Membrane structures have been widely applied in the field of large-span spatial structures because of the lighter self-weight, larger span and more beautiful shape. In this respect, the transparent membrane structures have some natural advantages in replacing traditional glass structure compared with the fabric membrane structures. For example, as the one of the most popular applications of the transparent membrane structures, ETFE cushion structures have been successfully used as building roof and façade in stadiums, gymnasiums, greenhouse gardens, exhibition halls, etc.

ECTFE foils have similar physical and chemical properties compared to ETFE foils, even some more excellent properties. Therefore, ECTFE foils have the ability to be one of the competitive constructive materials of transparent membrane structures. While being used in membrane structures, the mechanical properties of ECTFE foils are more essential compared with the excellent physical and chemical properties. In order to investigate the mechanical properties of membrane materials, uniaxial tensile test is one of the most commonly used methods, in which some mechanical parameters can be easily obtained by analyzing the tensile curves.

This paper thus is aimed to study the uniaxial tensile mechanical properties of ECTFE foils under different strain rates. Difference of mechanical properties of ECTFE foils between two directions was firstly investigated in order to verify the isotropy; meanwhile difference between two specimen shapes was also estimated for selecting a more suitable dimension. Eight groups of tensile strain rates ((0.02/min, 0.20/min, 0.50/min, 1.00/min, 2.00/min, 4.00/min, 6.00/min and 10.00/min)) were considered in the material test to examine the rate dependence of ECTFE foils comprehensively. Based on the stress-strain curves, the tensile strength, tensile strain at break, yield stress, yield strain and elastic modulus were analyzed and calculated. Based on the test results and analysis, some useful findings can be described as follows. The uniaxial tensile mechanical properties of ECTFE foils along MD and TD directions are almost identical. The stress-strain curves show obvious nonlinearity, in which there are four main stages of linear elasticity, strain softening, cold tension and strain hardening from the beginning of tension to fracture. The main mechanical parameters such as modulus of elasticity, yield strength, tensile strength and elongation at break show a non-linear exponential relationship with the strain rate. The nonlinear fitting formulas are also given, which can be used to predict the mechanical parameters of ECTFE foils under different strain rates.

## References

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