

**17th International Conference on  
Flow Processes in Composites Materials (FPCM17)  
Sheffield, United Kingdom, 30 June to 02 July 2026.**



**TITLE:** The First European Benchmark Exercise on Squeeze Flow Testing of High-performance Carbon Fibre Sheet Moulding Compounds

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**ABSTRACT:**

**Background**

Squeeze flow testing is an experimental method widely adopted in the field of rheometry, especially for studying highly viscous materials experiencing a high level of wall-slippage. This method has been adopted by several research groups for characterising the flow behaviour of Sheet Moulding compounds (SMCs), but due to the lack of a standardised testing procedure, the reliability and repeatability of this testing method remains low.

This paper presents a benchmark exercise on the squeeze flow testing of high-performance C-SMC, jointly delivered by a collection of European research institutions with in-house developed squeeze flow testing facilities. The main scope of the benchmark exercise is to improve the reliability and repeatability of the testing through an understanding of the sources of variabilities in the measured data and ultimately leading towards the development of a testing standard.

**Methodology**

Five vinyl ester (VE) based C-SMC materials are being investigated in this benchmark exercise to understand the effects of fibre content and rowing size on the flow behaviour of C-SMCs. A well-prescribed testing procedure has been implemented where detailed instructions have been provided on specimen preparation,

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testing setup, and testing procedure. Each participant has followed a unique, randomly generated testing sequence to identify, and possibly, eliminate systematic errors caused by variations in material storage and testing conditions.

Following completion of the testing campaign, four sets of raw data were collected from each participant, including testing information, unprocessed force–displacement data, scanned plan-view images of specimens after testing, and temperature–humidity history data from raw material production to final pressing. Specimen areal mass was used directly to assess material variability. Force–displacement data were further processed to follow a consistent sign convention and remove any systematic offsets in force and displacement measurements. Specimen images were processed using an in-house Python script to extract flow front profiles as two-dimensional point clouds. Statistical analyses were performed to determine mean values and standard deviations within and across participants, followed by a sensitivity analysis to assess the influence of testing facility, testing procedure, and specimen areal mass on the measured responses. Example results of force-displacement curves and flow front development profiles are presented in Figure 1.

**Anticipated outcome**

- Quantification of the variabilities in squeeze flow results within each participant and across all participants
- Identification of possible sources for the observed variabilities
- Understanding of the effects of material parameters such as fibre roving size and weight fraction on the flow behaviour of C-SMCs
- Improved testing procedure for a follow-up benchmark and as basis for a community-led testing standard development

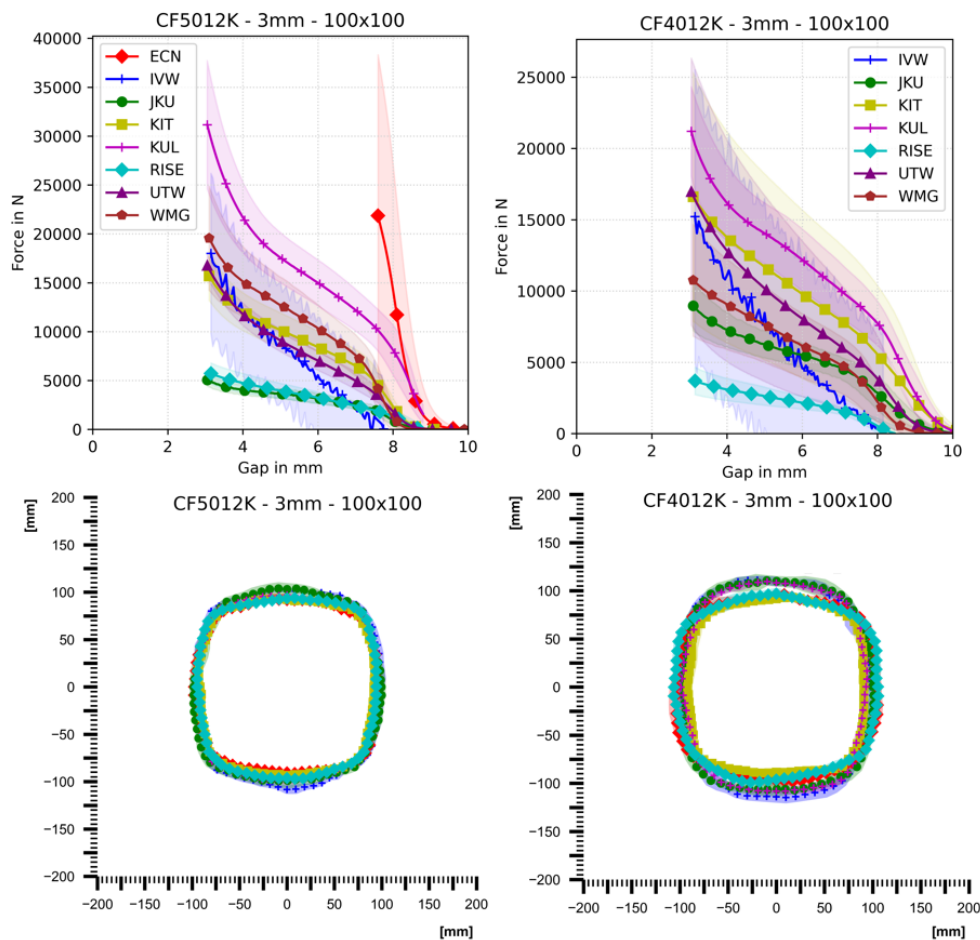


Figure 1. Examples force-displacement curves and flow front development profiles.

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