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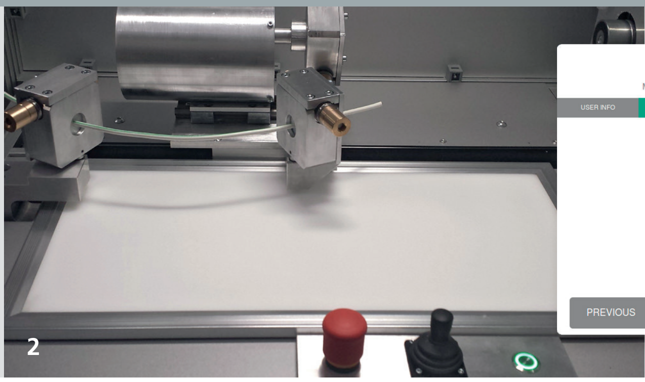
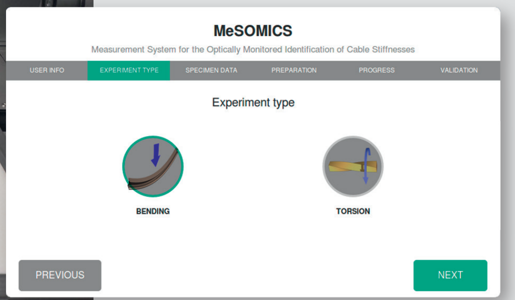

1 *MeSOMICS during a measurement*

2 *The inside of MeSOMICS*

3 *Preparation and control of measurement on a screen outside of MeSOMICS*

MeSOMICS – PARAMETER IDENTIFICATION FOR IPS CABLE SIMULATION

MeSOMICS stands for Measurement System for the Optically Monitored Identification of Cable Stiffness. It provides a full set of effective stiffness parameters for IPS Cable Simulation.

The preparation and assembling of specimens is very easy and the measurement is highly automated due to optical monitoring. Immediately after the measurement, the recorded data is evaluated in MeSOMICS. The resulting mechanical parameters are exported in HMD (Harness Model Description) format and can directly be loaded into IPS Cable Simulation.

The standard version of MeSOMICS enables the measurement of cables and hoses with diameters between 2 mm and 25 mm and allows free specimen length from 100 mm to 300 mm.

Effective mechanical parameters in IPS Cable Simulation

IPS Cable Simulation allows the interactive and physically correct simulation of cables and hoses for design and assembly. Especially for the accuracy of computed forces and moments in the structure, an exact knowledge of the effective mechanical parameters of the component is important.

These essential properties are:

- the effective bending stiffness EI
- the effective torsion stiffness GJ
- the effective tension stiffness EA

Here, E defines Young's modulus and G stands for the shear modulus. I, J and A indicate the geometric moment of inertia, the polar moment and the area of the cross section.

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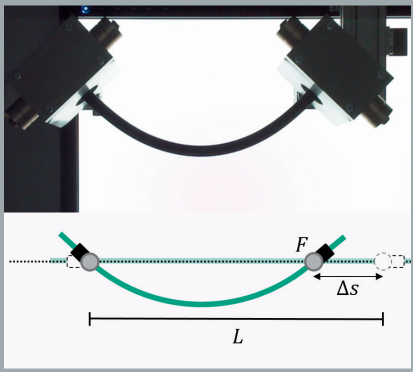

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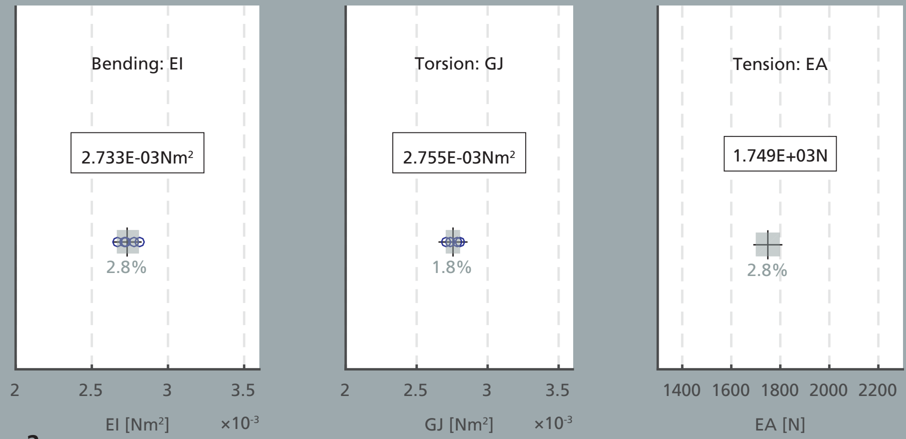

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1 *The bending test in MeSOMICS: schematic and actual test*

2 *Summary of measured mechanical parameters*

Young's modulus and shear modulus of most materials can be found in literature. Together with information about the cross section geometry, in principle this allows to compute the effective stiffness. However, practically relevant cables and hoses are composite structures and in general consist of several layers. Thus, it is not possible to compute their mechanical properties as for homogeneous components. Instead, the mechanical properties have to be determined by measurements.

Bending stiffness EI

The most important mechanical parameter for cable simulation is the bending stiffness, but also is most difficult to identify. The standard test, i.e. the 3-point-bending test, is well established for very stiff materials. However, for highly flexible structures like cables and hoses, it is only valid for very small deformations, far below real bending curvatures.

For MeSOMICS, an innovative bending test was developed. The specimen ends are clamped in low-friction bearings, such that they can pivot freely. By moving one mounting point towards the other, the specimen forms a bending. This design allows strong non-linear deformations in the range of practically relevant bending curvatures. Moreover, disturbing influences at the cable boundaries are minimized in the new bending test. During the test the displacement Δs, the resulting force F and the bending line is recorded. A camera detects the latter optically. Immediately after the measurement, an algorithm based on non-linear beam theory deduces the bending stiffness from recorded data inside of MeSOMICS. Additionally, the optical detection enables a direct theoretical verification of the identified bending stiffness and thus a robust algorithmic process is possible.

Torsion stiffness GJ

The torsion stiffness is identified with a standard test. Both ends of the cable are clamped and the specimen is twisted, while the torsion angle and the resulting moment is recorded. From this data, one can easily determine the torsion stiffness. Again, this is performed directly after the measurement inside of MeSOMICS.

Tension stiffness EA

Also for the tension stiffness, a standard test could be used. However, the correct assembling of specimens is decisive in this case. A hard clamping may damage the specimen, but a soft clamping may only fix the cable jacket and not its core. Consequently, instead of measuring the tension stiffness by physical tests, we prefer to determine this parameter computationally from the remaining measured effective stiffness and information about the cross section geometry.