

# Low torque measurements performed under every day conditions

Cornelia Küchenmeister, Jint Nijman and Fabian Meyer, Thermo Fisher Scientific, Process Instruments, Karlsruhe, Germany

## Key-words

- Low torque measurements
- Performance of air bearing
- Residual torque correction (Micro Stress Control)

## Instrument

- Thermo Scientific HAAKE MARS III
- TM-PE-P Peltier
- Plate P35 Ti

## Sample

- E2000 (Newtonian test fluid)

The Performance of a rheometer in the range of very low torques (nano Nm) plays an important role for the rheological investigation of low viscosity fluids (e.g. protein or polymer solutions) as well as for very sensitive samples at small deformation and for interfacial rheology. The aim is to perform such measurements under every day laboratory conditions in a short time and with a maximum precision.

Therefore the quality of the air bearing in terms of initial torque and smoothness is the crucial factor. The HAAKE MARS III contains a patented air bearing being on the one hand very sensitive and on the other hand very robust in terms of applied mechanical strains.

The air bearing system consists of one axial and two separated radial bearings, whereas the lower radial bearing is located below the axial bearing. The axial air bearing supports the measurement shaft in vertical direction and guarantees excellent axial stiffness. The two radial air bearings are centering and supporting the shaft in the radial direction.

A notch on the top of the rotor shaft of every cone and plate geometry guarantees that the radial orientation towards the motor shaft is always the same. After attaching the rotor to the motor shaft the residual torque of the entire rotating system, including air bearings, motor shaft and rotor is being determined. The measured torque values as a function of the absolute angular position are being stored in the rheometer electronics and can be used as correcting factors for future measurements. The residual torque which remains after this kind of correction is in the order of magnitude of a few nano Nm.

By utilizing this correction, measurements down to torque values of 10 nNm in rotation and down to

3 nNm in oscillation are feasible with a maximum deviation of 10 %.

## Measurements in the range of lowest torque values

After a single performance of the residual torque correction (MSC) the HAAKE MARS III is prepared for the most sensitive measurements. Using a plate / plate geometry with

a diameter of 35 mm the standard Newtonian calibration oil E2000 (1900 mPa·s at 20 °C) has been measured in rotation as well as in oscillation. To check reproducibility both measurements were being performed four times. The results reveal the lower limits of the measurement range of the HAAKE MARS III. Lowest torque values 10 nNm in rotation and 3 nNm in oscillation are available.

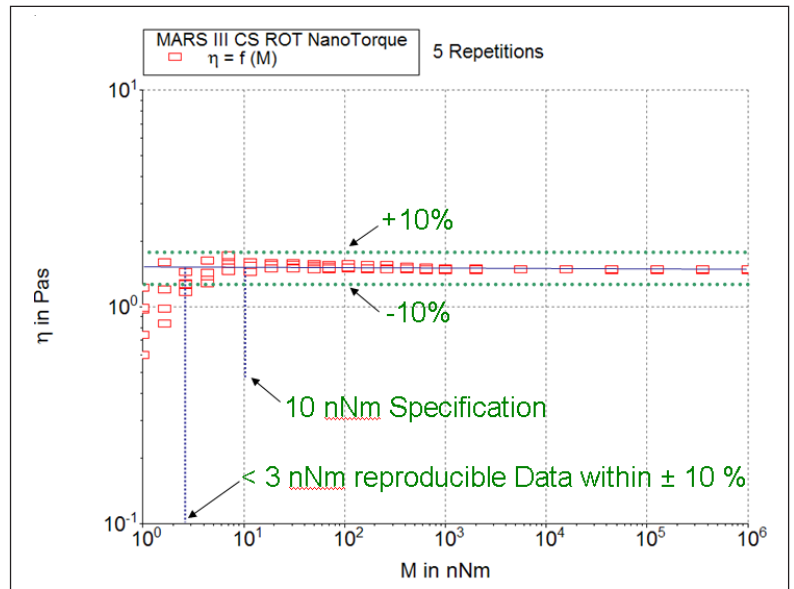


Fig. 1: Measurements in rotation approve the low torque specifications of 10 nNm for the HAAKE MARS III

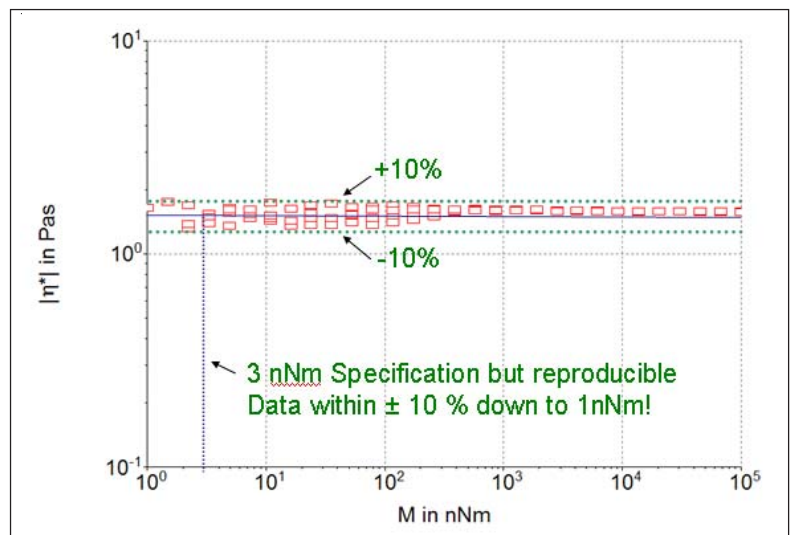


Fig. 2: Measurements in oscillation approve the low torque specifications of 3 nNm for the HAAKE MARS III

## Process Instruments

### International/Germany

Dieselstr. 4,  
76227 Karlsruhe  
Tel. +49(0)721 40 94-444  
info.mc.de@thermofisher.com

### Benelux

Tel. +31 (0) 76 5 87 98 88  
info.mc.nl@thermofisher.com

### China

Tel. +86 (21) 68 65 45 88  
info.mc.china@thermofisher.com

### France

Tel. +33 (0) 1 60 92 48 00  
info.mc.fr@thermofisher.com

### India

Tel. +91 (20) 66 26 7000  
info.mc.in@thermofisher.com

### United Kingdom

Tel. +44 (0) 1606 548 100  
info.mc.uk@thermofisher.com

### USA

Tel. 603 436 9444  
info.mc.us@thermofisher.com

[www.thermo.com/mc](http://www.thermo.com/mc)

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