# Measuring Machines for Automobile Suspension Joints

## Tests of Joint Mobility

Foreword

WPM Leipzig has developed and has successfully brought to market a range of testing and measuring machines for joints in automobile suspensions in conjunction with customer-specific factory standards.
This includes a range of customized machines for measuring and testing of suspension joints such as:

**(1) Joint mobility testing**
**(2) Joint wear testing**
**(3) Leak testing of the joints**
**(4) Determination of the quasi-static strength**
**(5) Working load testing**
**(6) Single-stage fatigue testing**

The company WPM Werkstoffprüfsysteme Leipzig GmbH offers various test and measurement machines for monitoring the named quality criteria. These machines are customized manufactured for measurements of joints of suspension in automobile chassis. WPM Leipzig has developed and manufactured a series of these machines in the last years.


ZERTIFIKAT

Die Zertifizierungsstelle der TÜV SÜD Management Service GmbH bescheinigt, dass das Unternehmen

WPM Leipzig Testing Machines

WPM Werkstoffprüfsysteme Leipzig GmbH
Nordstraße 15
D-04416 Markkleeberg

für den Geltungsbereich

Entwicklung, Herstellung und Vertrieb von Mess- und Prüfmaschinen einschließlich Servicedienstleistungen

ein Qualitätsmanagementsystem eingeführt hat und anwendet.
Durch ein Audit, Bericht-Nr. 76011311
wurde der Nachweis erbracht, dass die Forderungen der

ISO 9001:2008

erfüllt sind. Dieses Zertifikat ist gültig bis 2015-03-29
Zertifikat-Registrier-Nr. 12 100 7449 TMS

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Beyond that, we offer the possibility of joint mobility test in-house or at affiliated companies.

Since 2009, the quality management system of WPM Werkstoffprüfsysteme Leipzig GmbH is certified according DIN EN ISO 9001.

Within this technical information sheet, you will get an overview about the range of products of WPM Werkstoffprüfsysteme Leipzig GmbH regarding measuring machines of joints in automobile suspension**.** The joint mobility testing includes the determination of the breakaway movement and moments of resistance and the force-displacement curve in the axial or radial direction.

# 1. Measuring Machines to determine the Force-Deflection-Graph (Elasticity Measuring Machines)

The **Elasticity Measuring Machines (EMM)** developed by WPM Leipzig GmbH are used to measure the elasticity and the spring travel of suspension joints in two loading directions.

At first, the force-controlled loading actuator moves the joint pin against the joint housing in axial and then in radial direction.

After inserting the specimen into the measuring machine, the object will be mounted housing- and peg-sided. The load generator first moves the joint-peg against the joint housing in axial and then in radial direction. By a measuring sensor, which is located outside the measuring chain, the relative movement between the joint ball and the joint housing is measured. For a backlash-free mounting of the suspension joints in the elasticity measuring machine specially designed adapters are used.

Device for differential measurements (optional)

To increase the measuring accuracy of the measurement of elasticity in axial and radial direction, the installation of a differential measuring device is possible. With this device and the help of displacement sensors attached in axial and radial direction, the relative movement of the suspension housing is determined during the elasticity measurement. This can be removed from the measurement result through the software of the EMM, or it may be used to evaluate the safety (slippage of the joint in the housing).

Free clamping with span/clamping table and second force measuring chain (optional)

Optionally, a second force measuring chain can be mounted on the crosshead of the EMM. In conjunction with a special span table, which is mounted within the peg mounting, universal test setups can be realized. This optional load chain is used for example for special bodies and/or rare joints for which no adaptations are available, such as rocker lever and bending tests as well as for joint manufacturer typical test setups.

With the second force measuring chain, tensile and compression forces up to 10 kN are possible.

Adaption (optional)

To measure the different types of automobile suspension joints, special adaptions are needed, which allow the possibility of implementation into the machine. The adaption normally consists of a peg and a housing adaption as well as adjustment elements of the displacement-measuring device.

The peg adapter receives/mounts the ball pivot of the joint. It is adapted to the shape of the corresponding ball pivot. During the screwing process, a form-fitting and non-positive connection is created. The peg adapter is mounted hydraulically in the latch clamping device; a non-positive, play-free connection is created.

Semi-automatic elasticity measuring machines EMM-1423 for automobile suspension joints

Elasticity measuring machines EMM-1291 for automobile suspension joints with hydraulic clamping

Elasticity measuring machines with hydraulic clamping and additional measuring chain for free clamping

| | |
|---|---|
| Main area of application | Elasticity measurements on ball joints<br>(determination of force-deflection-graph) |
| Force generator | |
| Type | The required test force is generated:<br>• with screw jacks and servo drive or<br>• servo-pneumatically<br>depending on the type of construction |
| Parameters | Axial force: ± 6 kN (max. ± 10 kN)<br>Radial force: ± 6 kN (max. ± 10 kN)<br>Measuring accuracy of force signal: ± 1 % of nominal range<br>Measuring accuracy of displacement signal: ± 1.0 µm |
| Instrumentation and control | I&C device d*ynaSax-D3* |
| Specimen | A joint including its related adaptation,<br>Measurement in axial and radial spring deflection in a clamped support |
| Clamping of the joints | Automatically by hydraulic swing clamps and pneumatic toggle clamps |
| Environmental conditions | Ambient temperature: 0 ... 40 °C<br>Change of surrounding temperature must not exceed 5°C/hour |
| Electrical connection: | Operating voltage: 3 x 400 V; 50 Hz --- 3L, N, PE<br>Nominal power 3.1 KVA |

## 2. Measuring Machines to determine the Breakaway Moments and Movement Resistance Moments

The **Friction Moment Measuring (RMM)** machines of WPM are used to determine the friction torque, occurring when the suspension joint, mounted in a bearing shell, is moved.
Depending on the version of the suspension joint, either the friction-induced torque of rotation or the friction-induced torque of turning can be measured. For some types of suspension joints the specifications require a pretension in axial or radial direction during its friction moment measurement. This can be performed by the machine, too.

For the play-free assemble of the joints into the friction moment measuring machine, special designed adaptations are used.

Electronic Determination of the Stick-slip-behavior (Option)

For the electronic determination of the breakaway torque, the sticking friction and the sliding friction torque of the rotary drive the starting torque of the rotating drive increases in defined way until the joint breaks loose in the direction of rotation. The rotational speed is regulated to a constant value. The control of the drive reduces in defined way the driving torque until the joint stops by the friction again. The process is repeated again.

This method allows determining both the breakaway torque and the sticking friction torque and its development and the sliding friction moment with its development. The increase/decrease of the drive torque is predefined to Nm/sec, the rotational speed is given in °/sec. There are only oscillating rotary movements possible. Furthermore, the joint to be examined can be loaded optionally with an axial force. The force chain is designed up to max. 5 kN.

Mechanical Determination of the Stick-slip-behavior (Option)

With this option the installation space of the testing machine is expanded to make a stick-slip-measuring on the basis of the mechanical determination of stick and sliding friction torques with torsionally soft spring elements possible (additional axis).

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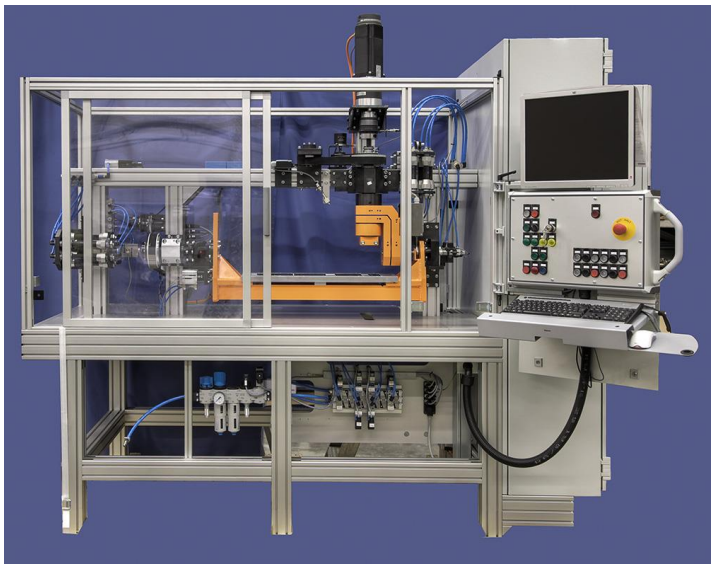
| Main area of application | Measuring of friction-induced torque of rotation or the friction-induced torque of turning of suspension joints (determination of moment-angle-graph)<br>Optional:<br>• Measurement of the break loose moment<br>• Determination of the stick-slip-phenomenon |
| Force generator | |
| Type | Servopneumatic |
| Parameter | Max. friction moment: 60 Nm<br>Max. break away moment: 60 Nm<br>Max. tilt angle: ± 35°<br>Max. rotation angle: ± 40°<br>Axial/radial force: 5 kN<br>Measuring accuracy of friction moments: ± 1% of end value<br>Measuring accuracy of rotation angle: ± 0.1° |
| I & C | I & C device d*ynaSax* |
| Specimen | Joint incl. its specific adaption<br>Measurement of all moments in a clamped support possible |
| Clamping of joints | Automatically by hydraulic swing clamps and pneumatic toggle clamps |
| Environmental conditions | Ambient temperature: 0 … 40 °C (optionally -30°C to + 80°C)<br>Change of surrounding temperature must not exceed 5°C/hour |



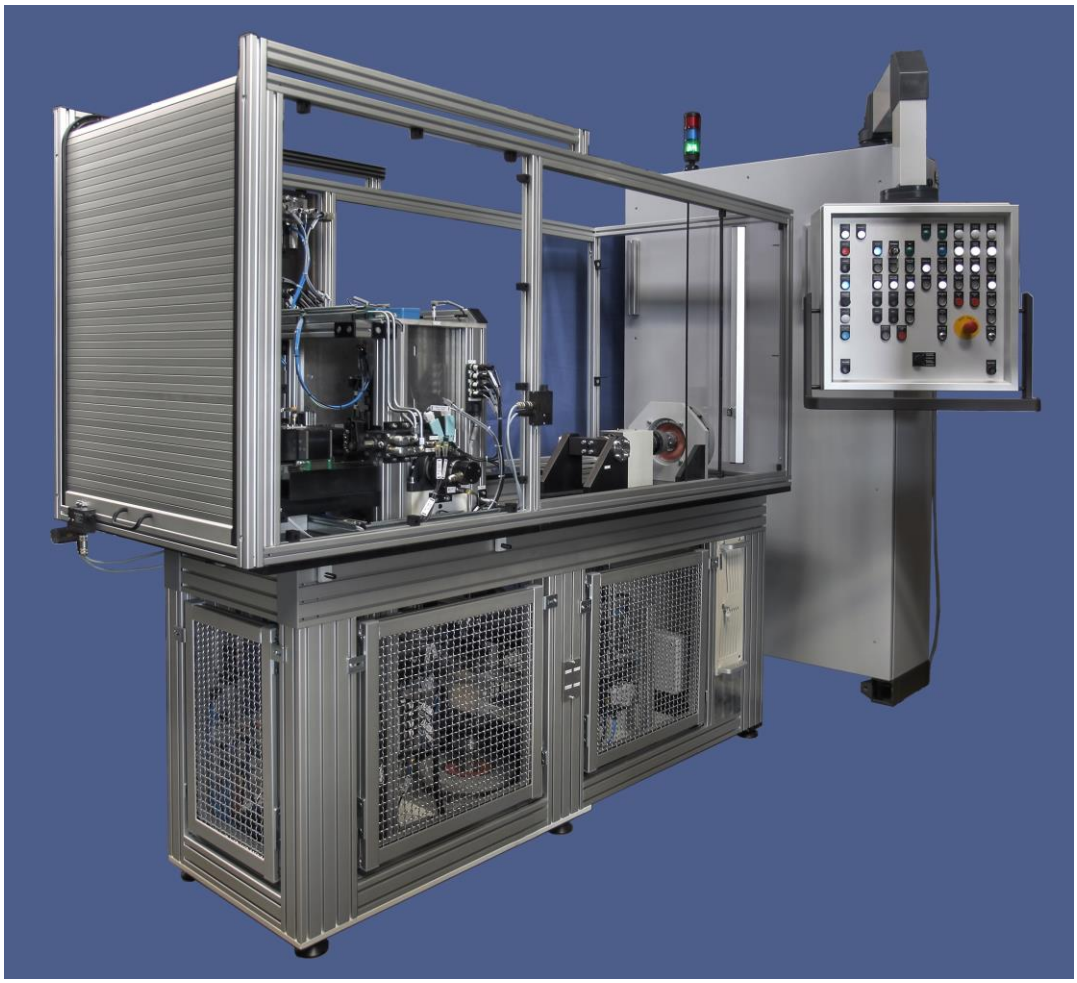
Friction Moment Measuring Machine RMM-12625 for suspension joints

Friction Moment Measuring RMM-1422 with hydraulic clamping

## 3. Combined Elasticity and Friction Measuring Machines (ERMM)

In addition to the separate measuring machines EMM and RMM as described above, combined elasticity and friction measuring machines ERMM are also available. Within this measuring machine all parameters of the single machines RMM and EMM are determined in one clamping and in one automated measuring sequence.

| | |
|---|---|
| Main area of application | Execution of elasticity measurements on ball joints (determination of force-deflection-graph) and measuring of friction-induced torque of rotation or the friction-induced torque of turning of suspension joints (determination of moment-angle-graph)<br>Optional:<br>• Measurement of the break loose moment<br>• Determination of the stick-slip-phenomenon |
| Force generator | |
| Type | Servo-pneumatic |
| Parameter | Max. friction moment: 60 Nm<br>Max. breakaway moment: 60 Nm<br>Max. tilt angle: ± 35°<br>Max. rotation angle: ± 40°<br>Axial force: 5 kN<br>Radial force: 5 kN<br>Measuring accuracy friction moment: ± 1% of end value<br>Measuring accuracy rotation angle: ± 0.1°<br>Measuring accuracy force signal: ± 1%<br>Measuring accuracy deflection: ± 0.5 µm |
| I & C | I & C device d*ynaSax-D3* |
| Specimen | Joint incl. its related adaption (measuring all parameters during one automated test sequence in a clamped support) |
| Clamping of the joints | Automatically by hydraulic swing clamps and pneumatic toggle clamps |
| Environmental conditions | Ambient temperature: 0 … 40 °C (optional -30°C to + 80°C)<br>Change of surrounding temperature must not exceed 5°C/hour |
| Electrical connection: | Operating voltage: 3 x 400 V; 50 Hz --- 3L, N, PE<br>Nominal power: 3.1 KVA |



Elasticity and friction measuring machines ERMM for automobile suspension joints

## 4. Instrumentation and Control System – Operating Software and Test Evaluation

All measuring machines are equipped with unified control and operating software, irrespective of the type of machine. The consistent operating philosophy allows the operator an easy change of the measurement programs or the measuring machines.

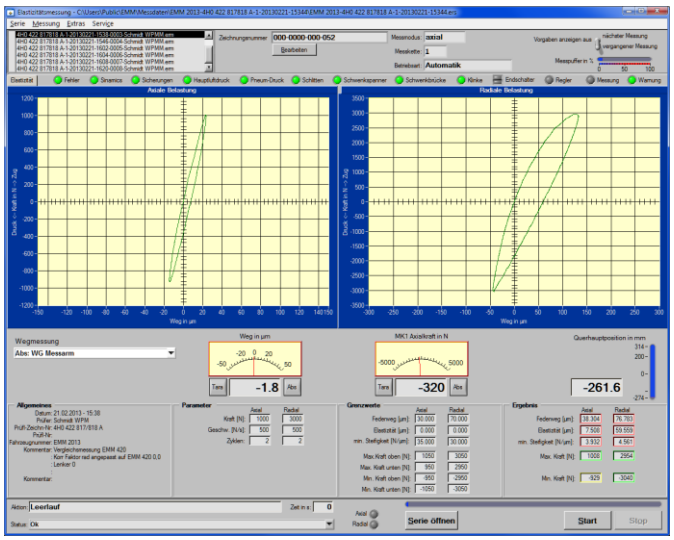
- All information on one page
- Display of the curves in real time
- Status of the machine components are displayed
- Pass/fail detection
- Display of the values
- Display of the experimental parameters

After selecting the measurement parameters and defining the measurement tasks (available depending on machine type)

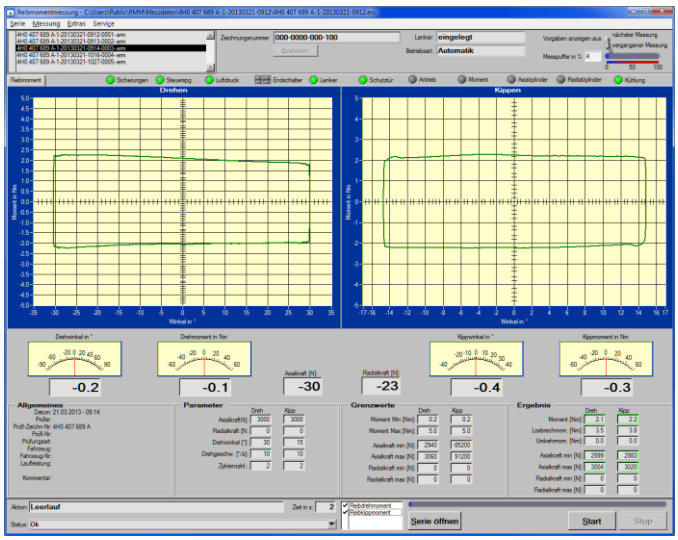
- Axial elasticity measurements (EMM, ERMM)
- Axial elasticity measurements (EMM, ERMM)
- Friction-induced torque of rotating with/without break loose moment measuring with/without standing time (RMM/ERMM)
- Friction-induced torque of turning with/without break loose moment measuring with/without standing time (RMM/ERMM)

the actual measuring can be started.

The selected measurements are fully automatic. The analysis of the measurements is displayed graphically on the screen and in the form of a printed protocol.



Operating menu elasticity measurement



Operating menu friction measurement

In addition to the fully automatic measurement functions, there are other features that simplify the interaction with the operator of the measuring machine and the handling of the data.

Including:

**Joint Database**

- Assignment of test parameters to a joint-/part number
- Several parameter sets per joint
- Allocation of required adapters for measuring storable
- Compensation values of the respective adapter stiffness storable

**Test parameters**

- For each joint-/part number the test parameters can be stored
- Necessary adapter can be stored

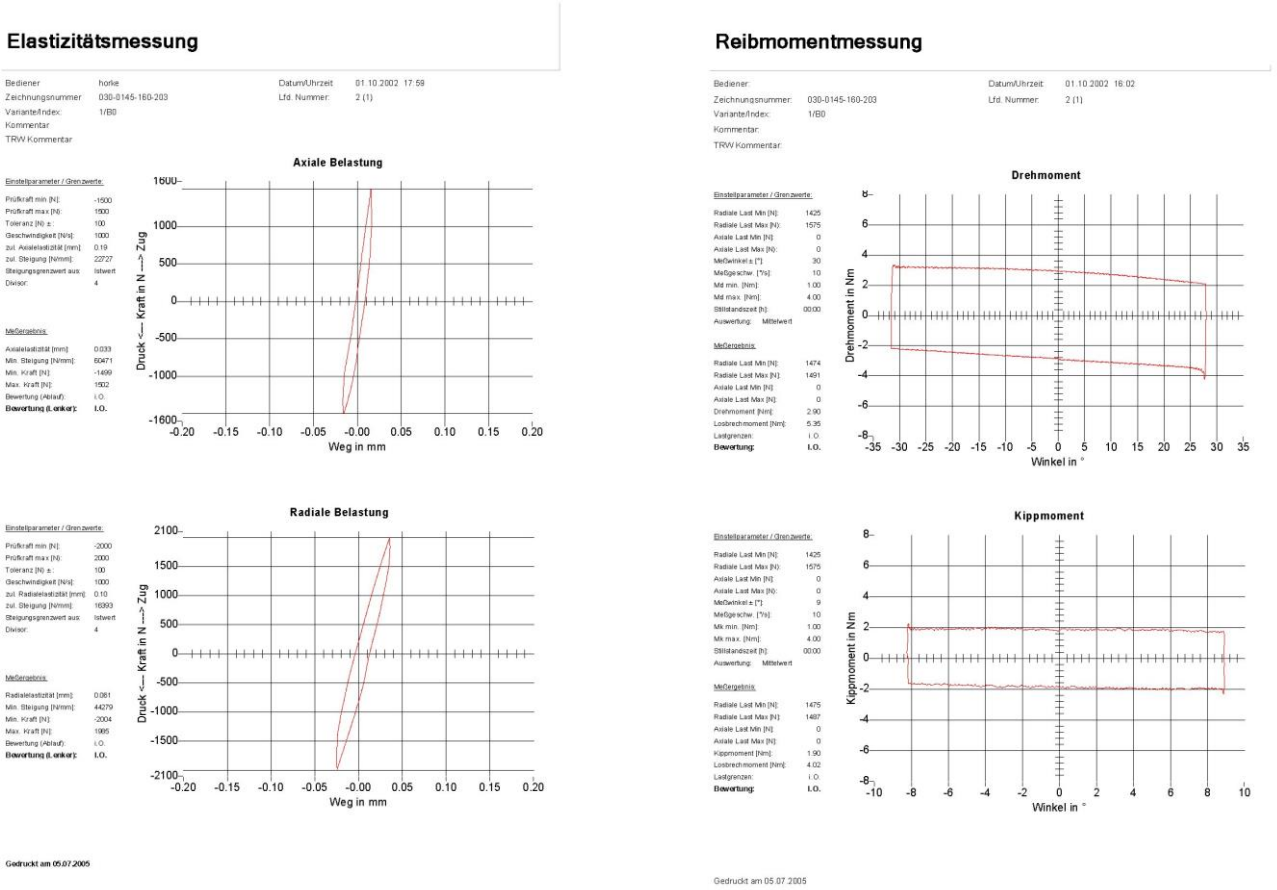
**Statistic functions**

At the measurements data sets/files are automatically generated, which contain all the characteristics of measurements and are therefore suitable for statistical reviews. All files are created in ASCII format and can be processed in MS Office programs, particularly MS Excel. In detail:

- Save the individual data files
- Create series of measurements
- Re-import of test series
- Calculating the average value
- Calculating standard deviation
- Margin calculation
- Calculation of min-/max values

## Logging

- Besides the online logging of measurements, a review of single measurement, whole series of measurements including statistical analysis (minimum, maximum, average, standard deviation of a measurement series) are possible.




Prints of protocols of elasticity- and friction moment measuring

## User rights

Different users can be created, with correspondingly individual rights to operate the measurement program.

## 5. References

- Audi AG, Ingolstadt
- DaimlerChrysler AG, Hamburg
- TRW, Krefeld
- HQM Sachsenring, Zwickau

WPM Werkstoffprüfsysteme
Leipzig GmbH

Gewerbegebiet Wachau
Nordstraße 15
04416 Markkleeberg
Germany

Phone: +49 (0) 3 42 97 14 35 - 0
Fax: +49 (0) 3 42 97 14 35 - 10

Email: info@wpm-leipzig.de
Internet: www.wpm-leipzig.de