TORSION MOTORS • HYDRO SWINGERS
Components for economically efficient
Four Square Test Rigs
The company

GAT - Gesellschaft für Antriebstechnik mbH with headquarters in Geisenheim, Germany, is a leading international technology company. For more than 30 years, GAT has been developing and producing tailored products for the most diverse industry applications in the electrotechnical transmission technology as well as fluid and sealing technology sectors.

GAT is technology leader in the production of test rig equipment, rotary unions, electrical slip rings, precision air bearings, as well as special-purpose equipment.

Our team of highly qualified engineers and product specialists offers competent expert advice by meeting the requirements of our customers and, choosing from our wide range of products, to deliver a standard or custom-made solution.

We design, produce and distribute high-tech precision products used in machine and plant engineering as well as energy generation worldwide.

The product specialists in our 18 sales offices located around the world make sure that customers receive competent technical advice and that economic considerations are taken into account. All this contributes to the success of our customers.

Our competence

As an innovative company that meets the challenge of the ever and always faster increasing requirements of modern technologies, GAT and their employees are constantly working on the evolution of equipment and products.

Our rotary unions and slip rings reflect our broad technological know-how, the focus on innovation and process optimization as well as the many years of experience we have in this business field.

GAT delivers complete systems from a single source and is the only manufacturer worldwide that designs, produces and distributes test rings, slip rings and rotary unions in-house. This guarantees best-in-class support for our customers throughout all production stages.

GAT customers benefit from certified quality and short delivery times, and our after-sales service ensures worldwide support.

At GAT, customer satisfaction always comes first. We believe in a long-term, reliable and fair cooperation.
The components

Developing new components for drive systems requires careful testing to ensure compliance with technical requirements. The reason for following this approach is not only the need to adhere to the applicable product liability laws but also because we aim for better performance and increased efficiency while reducing costs at the same time.

GAT is your ideal partner whenever you need to plan a test rig suitable for running full-load tests of drive elements subject to torsional forces. Benefit from our comprehensive range of mature modular products and rely on our unique know-how gained in over 30 years of hands-on experience. We will help you to find the best solution - all the way from planning and design to cost analysis and commissioning.

The torsion test rig with **energy recirculation and mechanical torsional-load generation**, generally called Four Square Test Rig, using a hydrostatic torsion motor has proved to be extraordinarily efficient in many areas of the relevant performance range (see also function description on page 10).

**Features:**
- Low energy consumption
- Low cost of investment
- Low operating and maintenance costs
- Optimal speed and torque controlling
- Pulsating, alternating and dynamic torque induction
- Suitable for integration into existing test rigs
- Fast start-up

**Product range:**
- Torsion Motor
- Hydraulic Supply
- Control Electronics
- Know-how
Torsion Motors VMC/EVC

Torsion Motors VMC/EVC comprise a hydraulic actuator and a rotary union. The hydraulic actuator is based on the swivel-vane principle. Its vane shaft is hydraulically suspended. Pressurized fluid is transmitted from the fixed housing part into the rotating hydraulic actuator by the rotary union. This represents the core element that ensures the operational reliability of the hydraulic supply to the rotating hydraulic actuator.

Our torsion motor is fitted with a cooling and lubricating system for highspeed operation. The valve unit comprising servovalve manifolds, pressure sensors and accumulators is directly attached to the rotary union. A hose line serves as connection to the hydraulic supply. The couplings are attached clearance-free to the shaft ends with an oil interference fit and a 1:50 taper.

Features:
- Non-contacting sealing system
- Hydrostatic vane mounting
- Resolution better than 1%
- Suitable for servo-hydraulic operation
- High dynamic response
- High natural frequency
- Very high primary speed
- Tough design
- Very long product lifetime

Torsion Motors VMC are especially suitable for applications requiring high resolution, high dynamic range and high primary speeds.

Torsion Motors EVC are realized as bearing mounted units for applications requiring higher speeds and/or dynamically reversing torque induction. In these units, the Torsion Motor VMC is spindle bearing suspended in a housing. The integrated bearings ensure a high axial and radial load capacity of both shaft ends. By using low-mass but torsionally rigid membrane couplings, high limit frequencies can be achieved. Torsion Motors EVC are also available in coaxial design.
### EVC 5.000 - 100 - RB - Running in bearing for inline mounting

**Type VMC Unit**

<table>
<thead>
<tr>
<th>Type VMC</th>
<th>Unit</th>
<th>500 - 100</th>
<th>1.000 - 100</th>
<th>2.500 - 100</th>
<th>5.000 - 100</th>
<th>10.000 - 100</th>
<th>19.000 - 100</th>
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<tr>
<td>Max. torque</td>
<td>Nm</td>
<td>1,000</td>
<td>2,000</td>
<td>4,000</td>
<td>10,000</td>
<td>20,000</td>
<td>40,000</td>
<td>80,000</td>
<td>150,000</td>
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<tr>
<td>Operating pressure</td>
<td>bar</td>
<td>210</td>
<td>210</td>
<td>160</td>
<td>210</td>
<td>210</td>
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<td>± 50</td>
<td>± 50</td>
<td>± 20</td>
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<td>Activator speed</td>
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<td>700</td>
<td>700</td>
<td>500</td>
<td>200</td>
<td>200</td>
<td>100</td>
<td>50</td>
</tr>
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<td>Speed</td>
<td>rpm *</td>
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<td>6,000</td>
<td>5,000</td>
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<tr>
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<td>8.9</td>
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<td>177.9</td>
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<td>145</td>
<td>180</td>
<td>252</td>
<td>310</td>
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<td>520</td>
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<td>40</td>
<td>55</td>
<td>80</td>
<td>90</td>
<td>100</td>
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<td>120</td>
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<td>575</td>
<td>790</td>
<td>840</td>
<td>996</td>
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<td>kg</td>
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<td>39</td>
<td>75</td>
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<td>I</td>
<td>I</td>
<td>I</td>
<td>I</td>
<td>I</td>
<td>F</td>
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<td>I,RB</td>
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<td>I,F,RB</td>
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</table>

* In standard design, ** On request, *** Shaft 1:50 Taper, **** Design: I=Inline, F= Cantilever, RB= Unit Running in Bearings, Other sizes and custom variants on request.
Torsion Motors VM/EV

Torsion Motors VM/EV comprise a hydraulic actuator and a rotary union. The hydraulic actuator is based on the swivel-vane principle. The vane shaft is suspended in friction bearings. Pressurized fluid is transmitted from the fixed housing part into the rotating hydraulic actuator via the rotary union. The rotary union is the core element ensuring the reliable hydraulic supply of the rotating hydraulic actuator.

**Features:**
- Low leak-oil volume
- Suitable for servo-hydraulic operation
- Medium primary rotational speeds
- Tough design
- Long product lifetime
- Cost-efficient

The servovalve manifolds unit and pressure sensors are usually attached to the rotary union by a hose line.

Torsion Motors VM/EV are especially suitable for applications requiring a cost-efficient solution with or without servo-hydraulic system for quasi-static operation up to medium rotational speeds. The couplings connecting the shaft ends are torsionally rigid, though flexible in axial direction.

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**Type VM**

<table>
<thead>
<tr>
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<th>Unit</th>
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<td>± 50</td>
<td>± 50</td>
<td>± 50</td>
<td>± 50</td>
<td>± 60</td>
<td>± 60</td>
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<td>degrees / sec</td>
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<td>94</td>
<td>83</td>
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<td>20</td>
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<td>2,500</td>
<td>1,500</td>
<td>1,500</td>
<td>1,500</td>
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<tr>
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<td>71.1</td>
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<td>310</td>
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<td>mm ***</td>
<td>230</td>
<td>340</td>
<td>380</td>
<td>520</td>
<td>570</td>
<td>700</td>
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<td>mm **</td>
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<td>85</td>
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<td>631</td>
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</table>

* Designs: I=Inline, RB=Unit Running in Bearings, F=Cantilever, ** Shaft: Involute splines according to ANSI B92.1-1970 class 5, Centered splines, *** Hydraulic actuator - custom variants e.g. with unlimited rotational angle on request.
**Hydro Swing HSC/EHC**

Hydro Swing HSC/EHC comprise a hydraulic actuator with attached servo-valve block and angle sensor. The hydraulic actuator is based on the swivel-vane principle. The valve unit comprising servovalve manifolds, pressure sensors and accumulators is attached to the valve block and is attached to the hydraulic supply. The shaft ends are coupled by a 1:50 taper. The coupling flanges are attached clearance-free with an oil interference fit.

**Features:**

- Hydrostatic vane mounting
- High degree of rigidity
- Non-contacting sealing system
- High resolution possible
- Tough design
- High dynamic response
- Direct torque generation
- Non-contacting sealing system
- Wide frequency range

The Hydro Swinger HSC is especially suitable for tests at high frequencies and large torsional angles.

### Type HSC

<table>
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<tr>
<th>Feature</th>
<th>Unit</th>
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<th>1,000 - 100</th>
<th>2,000 - 240</th>
<th>2,500 - 100</th>
<th>5,000 - 100</th>
<th>10,000 - 100</th>
<th>19,000 - 100</th>
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<tbody>
<tr>
<td>Max. torque</td>
<td>Nm</td>
<td>1,000</td>
<td>2,000</td>
<td>4,000</td>
<td>5,000</td>
<td>10,000</td>
<td>20,000</td>
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<td>± 50</td>
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<td>700</td>
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<td>100</td>
<td>100</td>
<td>50</td>
<td>50</td>
<td>50</td>
<td>50</td>
</tr>
<tr>
<td>Absorption volume</td>
<td>cm³ / degrees</td>
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<td>1.8</td>
<td>3.6</td>
<td>4.5</td>
<td>8.9</td>
<td>17.8</td>
<td>33.8</td>
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<td>mm</td>
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<td>145</td>
<td>238</td>
<td>180</td>
<td>252</td>
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<td>395</td>
</tr>
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<td>55</td>
<td>55</td>
<td>55</td>
<td>55</td>
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<td>90</td>
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<td>500</td>
<td>610</td>
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<td>90</td>
<td>70</td>
<td>130</td>
<td>260</td>
<td>350</td>
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</tbody>
</table>

* Shaft: 1:50 Taper, ** Hydraulic actuator only - Other sizes and custom variants on request.
The Hydraulic Supply HA unit provides the hydraulic energy to operate torsion motors or hydro swingers. It also cools and filters the hydraulic oil. The unit comprises a hydraulic unit and a control unit. Its modular control system can be extended to allow the controlling and monitoring of systems with several individual drives.

It can also be extended to control and monitor the lubrication of gearbox and/or rotary drive. Remote operation is possible. Energy is dissipated via an oil-to-water or oil-to-air heat exchanger.

If a connection between hydraulic supply and torsion motor is not suitable for function or if the distance is too long, then suitable leakage oil units are available.

### Features:
- Compliant with the requirements of GAT Torsion Motors
- Long maintenance cycles
- Long product lifetime
- Separate cooling circuit
- Simplest operation
- Fast start-up

### Specifications:

<table>
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<tr>
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<td>35 / 45</td>
<td>60 / 80</td>
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<td>3</td>
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<tr>
<td>Cooling medium</td>
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<td>15</td>
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<td>400</td>
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<td>1.35 x 0.8 x 1.7</td>
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<td>400</td>
<td>480</td>
<td>700</td>
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</table>

* With control cabinet, ** Without oil filling
Control Electronics RE

The Control Electronics RE is especially designed for use in Four Square Test Rigs with GAT Torsion Motors. Operational reliability, fast start-up and flexibility are the key features of the GAT Control Electronics RE. Depending on the application either torque or torque angle are used as control parameter. Setpoint values can be specified either by function generators or by process controllers.

Features:

- Modular design in 19"-rack system
- PID controllers with adjustable limit values, ramps and control definitions
- Digital display for displaying values in %
- LCD for control parameters
- Start-Stop unit for fast start-up
- Controller programming via keyboard in front panel
- Matching amplifier for adjusting input and output signals
- Measuring connectors for the relevant parameters on front panel
- Setpoint potentiometer on front panel for manual operation
- Controller inhibits with external control
- Shake-proof and polarity-coded connectors
- Adjustable damping of control torque in controlled loop
- Free operational amplifiers for application-specific adaption
- Profibus interface (Option)

Abstract of tracing the driving cycle *Nürburgring*

red - set values of torque
blue - actual values of torque

performed by EVC 2500-100-RB, speed up to 8,000 rpm, 1 VDC corresponds to 400 Nm
The Four Square Test Rig with GAT Torsion Motors

The power circulates in the mechanically closed loop via the first test rig gearbox, the torsion motor, the second test rig gearbox and the sample, or, depending on torsional direction and sensor of rotation in reverse direction. The torque will be generated by impinging the torsion motor with hydraulically pressure within the closed loop.

The drive is dimensioned only to compensate for friction loss and to control the rotational speed of the system. This design is especially efficient because only the energy dissipated by the rotating components, typically 15% of the circulation energy, must be generated.

Loads can range from quasi-static to dynamic loads with frequencies. Depending on the GAT Torsion Motor and its dimensions, torsion angles may range typical from ± 50°C to ± 75°C.

More information about Torsion Motors VMS for systems subject to slip on request.
Full-load testing of drive shafts and joints (CV shafts)
Torsion motor EV 4,000-100
- Torque up to 6,000 Nm
- Speed 2,500 rpm
- Cantilever mounted torsion motor

Full-load testing of 80,000 kW power plant gearboxes
Torsion motor VMC 100,000-40
- Torque up to 200,000 Nm
- Speed 4,000 rpm
- ± 20° torsion angle
- Cantilever torsion motor inline mounting

Full-load testing of Maritime gearboxes
Torsion motor EV 100,000-120-RB
- Torque up to 150,000 Nm
- Speed 1,500 rpm
- ± 50° torsion angle
- Inline mounted torsion motor, running in bearing

Full-load testing of wind turbine gearboxes
Torsion motor EV 20,000-100-RB
- Torque up to 30,000 Nm
- Speed 2,600 rpm
- ± 50° torsion angle
- Inline mounted torsion motor
- Torsion unit running in bearing
Our Product Portfolio

- Rotary Unions
- Electrical Slip Rings
- Precision Air Bearings
- Test Rig Technology
- Special Equipment

GUARANTEED QUALITY MANAGEMENT
GAT - Gesellschaft für Antriebstechnik mbH