LOAD SPECTRA FOUR SQUARE CVJ ENDURANCE TEST RIG
Technical description

1) Mechanical set-up

This 'back-to-back' test rig utilizes the power loop principle, also known as four-square configuration. The rig consists of two gearboxes connected by shafts with constant velocity joints (CV-Joints). In the middle between the four test shafts is a horizontally moveable drive-block which realizes the deflection angle. This drive-block is moved by a spindle device.
One shaft has a hydraulic load clutch for the application of the torque. The hydraulic load clutch including hydraulic system and the spindle devices are connected to the control unit of the test rig, so that the load, the deflection and the steering angle can be changed automatically by the computer of the control system. The measurement of the torque is carried out with a contact-free torque measurement system. The deflection angle is calculated by the computer system using the shaft length and the deviation of the spindle device.
The test rig is powered by an electric motor with a variable speed control from 100 up to 4500 rpm and two directions of rotation. The motor is placed parallel over the shafts and drives the system using a poly-V belt.

The test rig is designed to test 8 CV-Joints with one test run. The joints can be cooled by radial fans (air stream simulation) or also be heated up when using the heating chambers which are connected to four heating cartridges. Cooling and heating of the CV-Joints is also programmable and controlled by the control unit.

The delivery includes also a set of 8 special designed flanges to change the joints easily in a very short time (ETP-system).

The gear boxes are designed this way that both shafts have the same direction of rotation (three gears). Due to the three-gear-configuration inside the gear boxes the required center distance can be realized with moderate pitch line velocity of the gears. The gears are designed for long-term application. The lubrication of the gearboxes is carried out by a spray lubrication system, which serves both test gear boxes with the lubricant oil. This spray lubrication unit is also cooling (air cooler) and filtering the oil.

All mechanical components of the rig such as gear boxes, bearing blocks and spindle-moving units can be moved and fixed on the casting plate, so that different flange to flange distances can be realized.

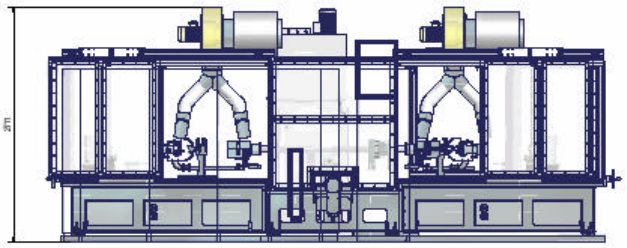
Windows made of Makrolon are included in safety guards, so that the test joints can be observed while running.

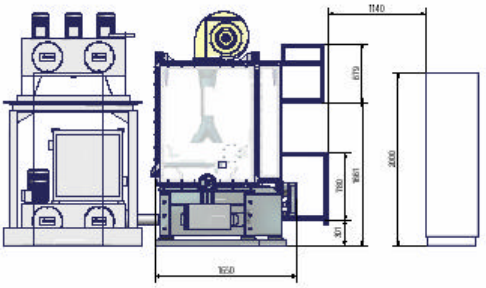
Also included are 2 manually adjustable vibration switches, which will stop the rig in the case of high vibration (damage of joints etc.).

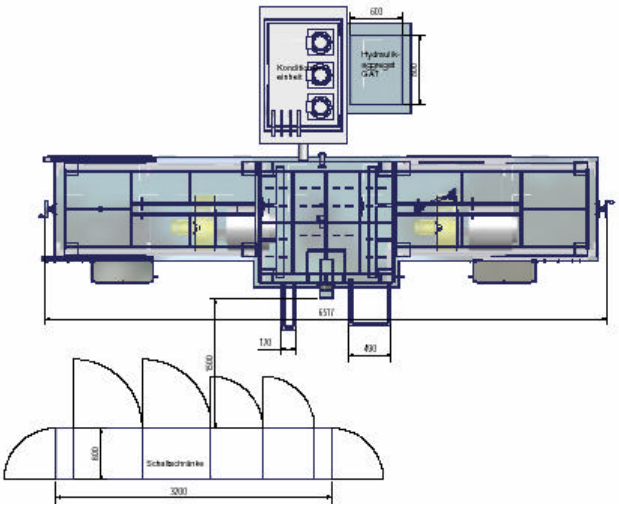
The outside temperature of the 8 CV-Joints is carried our by Infrared sensors.

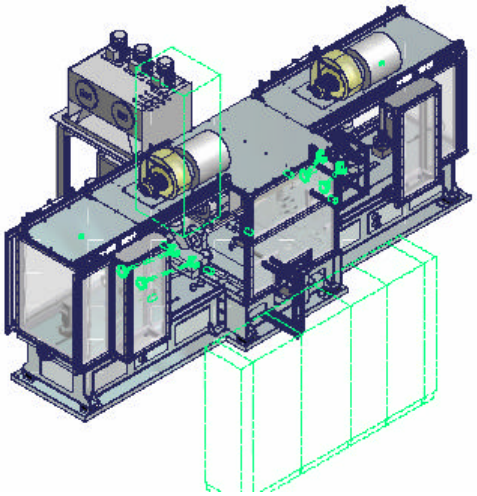
The data logging and the visualization of the test data is carried out with an industrial personal computer.

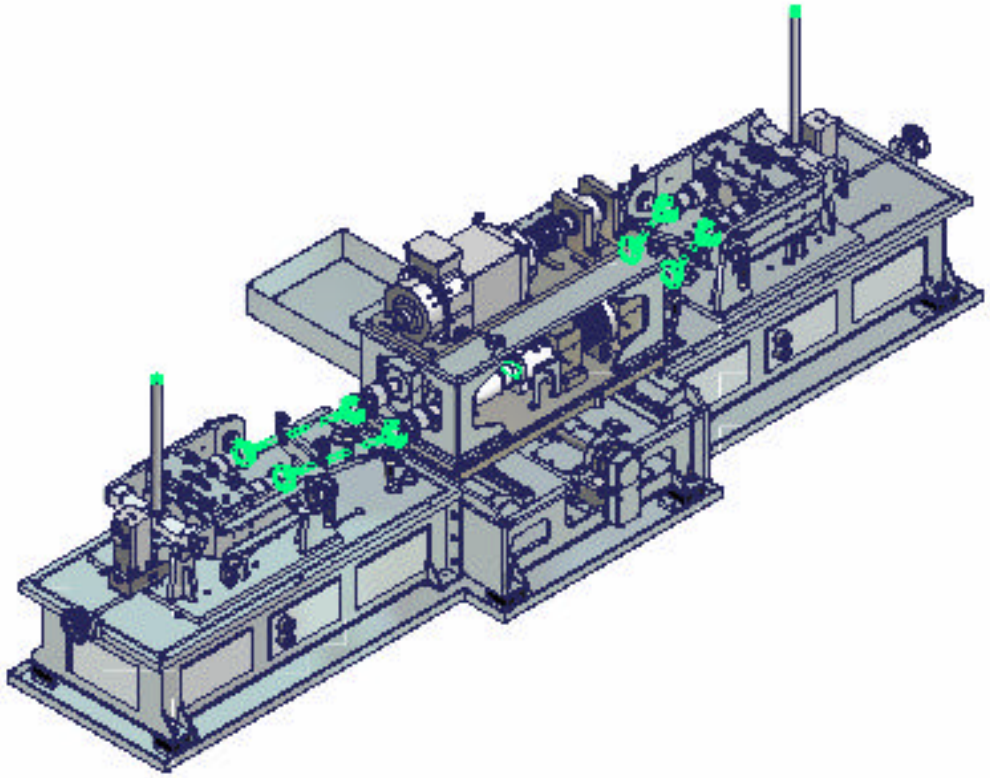
2) Layout of the system









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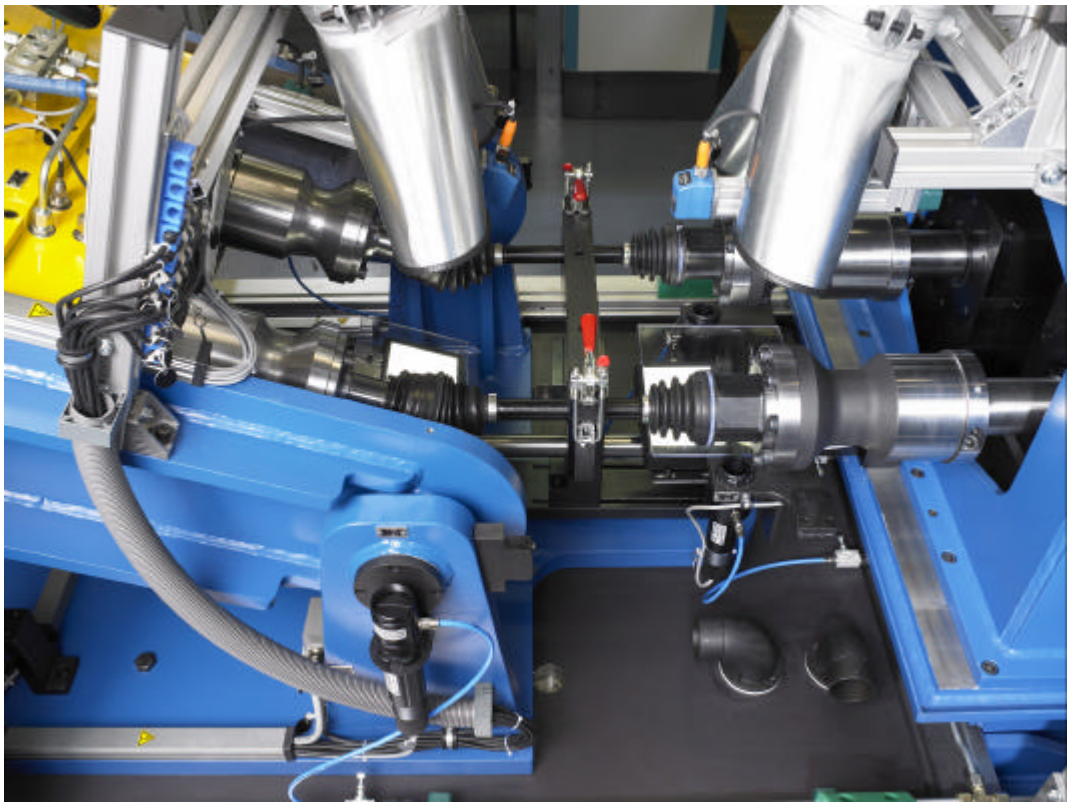
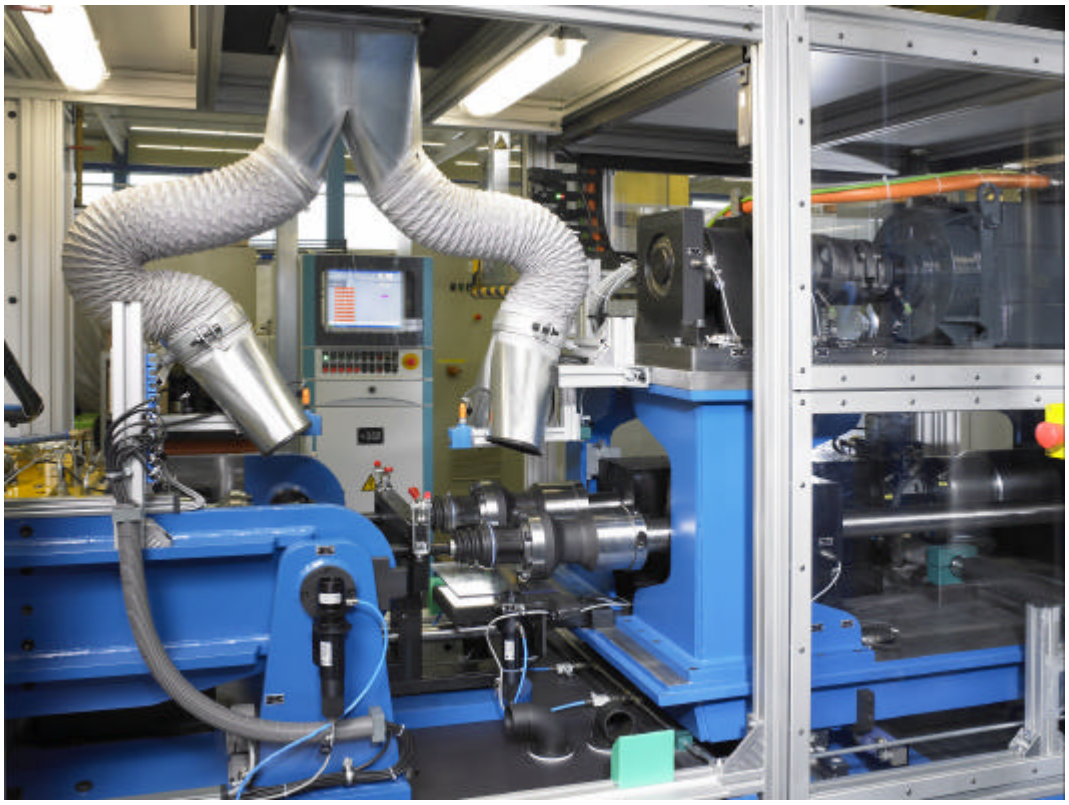




3) Technical data

3.1) Gear boxes

- Center distance: > 300 mm (to be clarified)
- Face width: 60 mm
- Helical gears
- Gear ratio: 1:1
- 3 gears
- Input and output shaft have the same direction of rotation
- Oil sump temperature is measured and displayed on the control unit. It can be used as switch-off criterion for safety reasons.
- Both gear boxes are equipped with adjustable vibration sensors

3.2) Lubrication

Both gear boxes are lubricated by oil-spray lubrication unit including air cooler and filter unit 10 µm

- Cooling power: 15 kW at ambient air temperature of 20 °C
- Pump power: 52 Liters/min at 1450 rpm
- Motor power: 1,8 kW/50 Hz/1450 rpm
- Oil filter: Type': LPF 160, 10 µm
- Optical display

3.3) Drive motor

The motor is a Siemens Type 1PH7 compact asynchrony motor.

- Type. Siemens 1PH7186-2NE00-0JJ0
- Power. 60 kW
- Motor speed: 100 – 4500 rpm
- Both directions of rotation
- Characteristic speed/torque points:
  - 0-1500 rpm: 458 Nm
  - 2000 rpm: 280 Nm
  - 3000 rpm: 200 Nm
  - 4500 rpm: 130 Nm

3.4) Torque setting

The torque setting is realized with a servo hydraulic load clutch Type GAT SVC 2000-100.
The hydraulic unit of the load clutch is also connected to the main control unit and is controlled by the main control unit of the test rig, so that load spectra can be realized.

- Max. Torque: ± 3000 Nm
- System pressure: 160 bar
- Torsion angle: ± 50 degrees
- Actuator speed: 700 degrees / sec
- Max. Speed: 5000 rpm
- Air cooling included

3.5) Torque measurement

The torque measurement is realized by a Torque Flange.
- Max. Torque: ± 10000 Nm
- Accuracy: ± 0,1 % M_N
- Rated speed: 8000 rpm
- Speed measurement system included

3.6) Heating, Cooling of the CV-Joints

Included in the delivery are 4 heating cartridges á 3000 W including fans and removable heating chambers which heat up the joints to a maximum temperature of 160°C.
For the air stream simulation with ambient air there are 2 radial fans, which can be used when the heating chambers are removed.
Air velocity variable 10 m/s up to 20 m/s, nozzle diameter 120 mm for 8 CV-Joints

3.7) Temperature measurement

The outside temperature of the test joints is measured by 8 Infrared temperature sensors.
- Type: Ahlborn AMiR7838-11
- Temperature range: -18 up to 500 °C
- Accuracy: ± 1% max. ± 1,4 °C
- Protected with air jet

3.8) Deflection angle

The variability of the deflection angle is carried out by a horizontally moveable drive-block between the four joint shafts. The range is 0° … 20°.

3.9) Steering angle

The variability of the steering angle is carried out by vertically rock-able gearboxes driven also by a spindle device.
The range is 0° … 60°.

3.10) Control Unit

The control unit runs the test rig automatically. Pre-programmed or recorded torque-speed-temperature spectra can be imported (ASCII, or EXCEL).
The data logging and visualization is also carried out by the computer in the control unit. The data logging and visualization is custom made by Strama-MPS and can be customized as per customers request. All functions of the test rig, the hydraulic load clutch and the heating or cooling of the CV-Joints are controlled by this control unit using a Siemens S7 PLC system.
The visualization is in English language.
The following data can be pre programmed and imported:
- Speed
- Torque
- Deflection angle
- Steering angle
- Cooling on/off
- Heating temperature of the 4 heating chambers

3.11) Data acquisition and visualization

The data acquisition is carried out by HBM sensors, HBM MGC plus and HBM ML30B single amplifiers.
The following parameters are recorded and displayed by the computer system:

- Motor speed
- Torque
- Deflection angle
- Steering angle
- 8 outside temperatures of the CV-Joints
- Oil sump temperature of the gear boxes

The above mentioned parameters are displayed as curves and digital data. All these data are stored within 1 second intervals.
The following features are also included:

- Customizing of the front end (display) as per customers request
- The possibility to import test procedures (spectra) which are programmed on another computer (Excel or TXT – Files)
- Zoom function
- Switch on and off curves while the system is running
- A history user and error messages
- Safety switch-off programmable for all displayed parameters
- Automatic and manual-function mode
- Separate window to display actual values

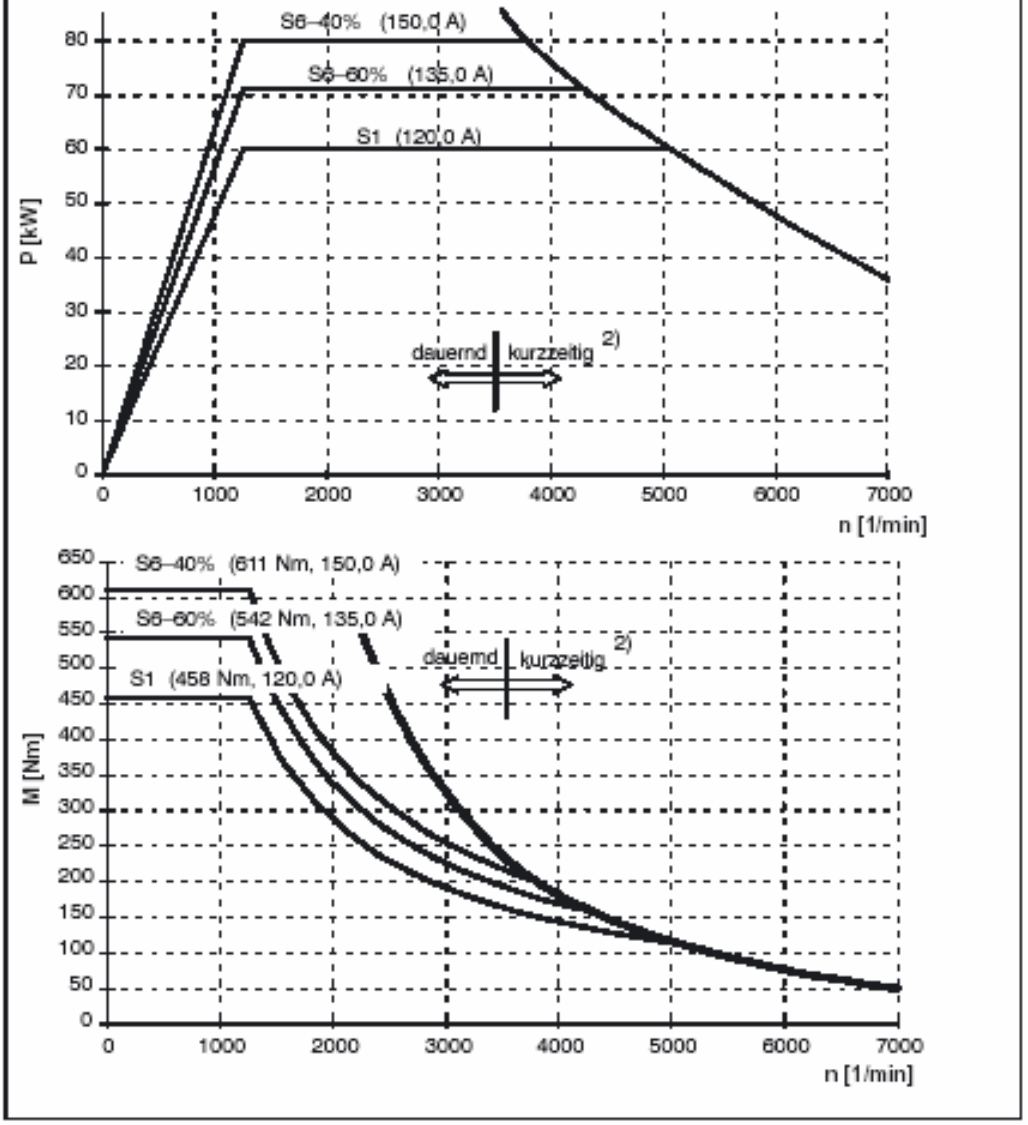
3.12) Safety equipment

The safety equipment of the test rig such as Emergency switches, protective grids and locking systems corresponds to the European Safety Regulations (CE-Conformity).
The system includes also two vibration switches, which shut off the test rig in the case of CV-Joint damage. This vibration switches can be adjusted manually by the customer and protects the rig of damages.

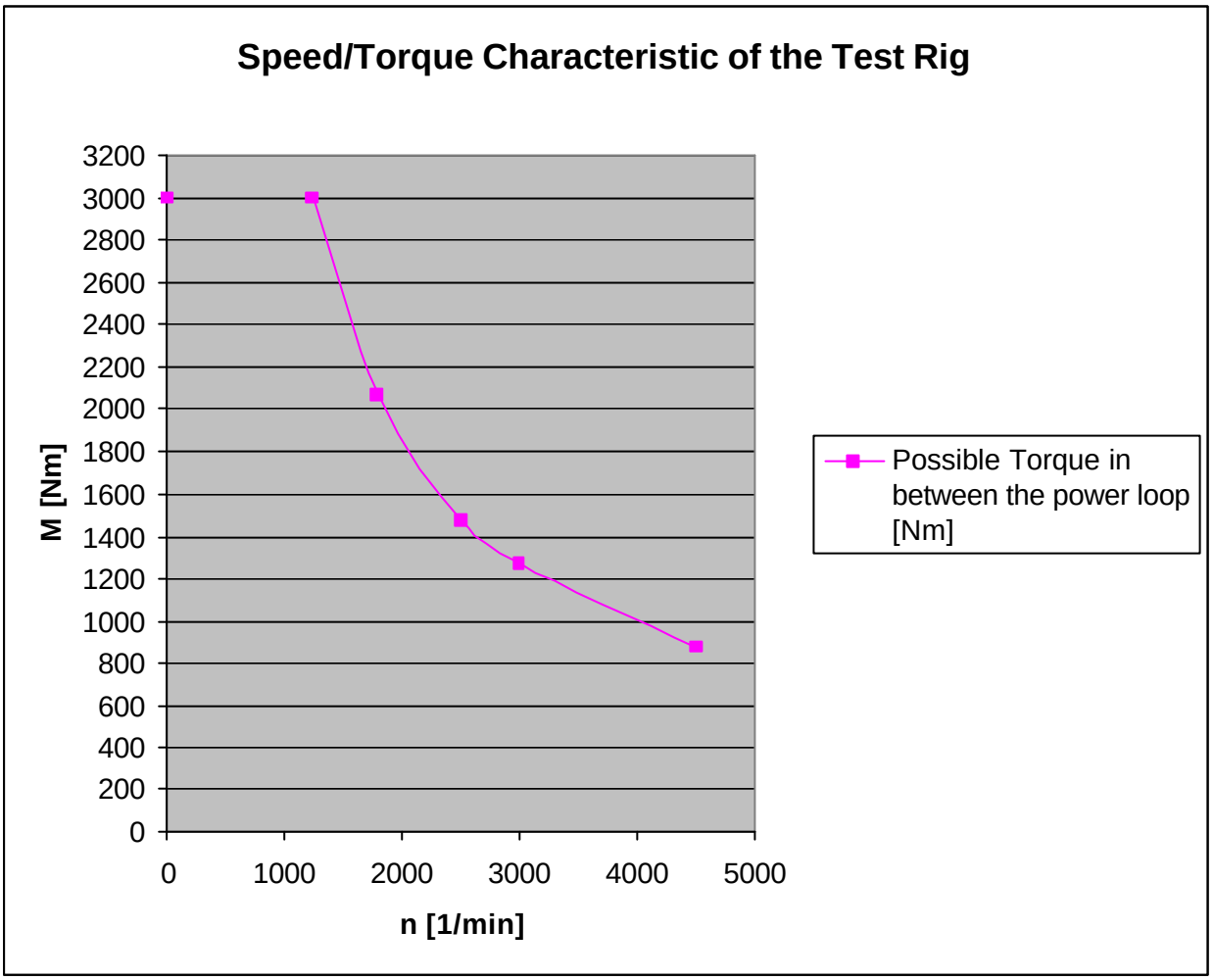
4) Speed/Torque Characteristics of the 4 square test rig

4.1) Motor

P_N [kW]	n_N [1/min]	M_N [Nm]	I_N [A]	n_{max} [1/min]	T_{th} [min]	J [kgm²]	m [kg]
60	1250	458	120	5000 7000 1)	40	0,67	460



4.2) Test Rig


Speed/Torque Characteristic of the Test Rig
M [Nm]
3200
3000
2800
2600
2400
2200
2000
1800
1600
1400
1200
1000
800
600
400
200
0
0
1000
2000
3000
4000
5000
n [1/min]
Possible Torque in between the power loop [Nm]

5) Installation, Commissioning and Acceptance Checking

5.1) Acceptance of construction (design review)

When the design of the test rig is finished, the engineers of Strama-MPS and the responsible persons of the customer will make a design review. Both parties will sign the drawings and confirm the design.

4.2) Pre-Verification and Training at Strama-MPS

The entire system will be assembled, installed and commissioned at Strama-MPS to carry out pre-verification together with the customer.

4.3) Installation, Commissioning and Training at customers site

After the installation and commissioning and training at the customers site the final verification and acceptance certificate will be signed by both parties.

5) Documentation

- Configuration chart (layout)
- Connecting chart
- Item List of the machine
- Electrical wiring diagrams
- Documentation of all supplier parts
- Test protocols
- Declaration of CE-Conformity

6) Warranty

The following warranty applies for the equipment made by Strama-MPS:

- The warranty period is 12 months
- For purchased parts the warranty regulations of the respective manufacturer are binding and he is responsible for the warranty respectively.
- Except from warranty are:
  - Wear parts
  - Damages caused by improper operation
  - Damages due to Force Majeure (Acts of God, disasters etc.)
- Warranty by Strama-MPS is only granted if proper maintenance and cleaning by qualified specialists is provided for the machine.
- The contractor is not liable for loss of production or profit.
- Emergency technical support per telephone and technical support on-site within 48 hours of equipment failure

7) Quality management system

Strama-MPS is certified according to the following standards:
- DIN EN ISO 9001:2000
- DIN EN ISO 14001:2004
- VDA 6.4 (High Level Standard of the German Automotive Manufacturer)

8) Health, Safety, Environment and Quality

- Safety housing: Included
- Transparent panels: Included
- TüV approval: The rig is designed according CEC-, UVV- and VDE- regulations. A TüV approval at your facilities is included in the price.
- PC-Operation: Included
- Quality standards: Strama-MPS is certified according DIN EN ISO 9001:2000 and VDA 6.4. (Higher requirements of the German Automotive Industry).
- Design and munufacturing according CE-Regulations
- CE-Certificate of confirmation
- Threat analysis (together with the customer if designated)
- FMEA (together with the customer if designated)

9) Delivery Time

The delivery time is depending very much on the customers requirements.
Realistic are 9 … 12 Month after singning the contract.