Electro-Hydrostatic Drive Concept for the Ring Rolling Process

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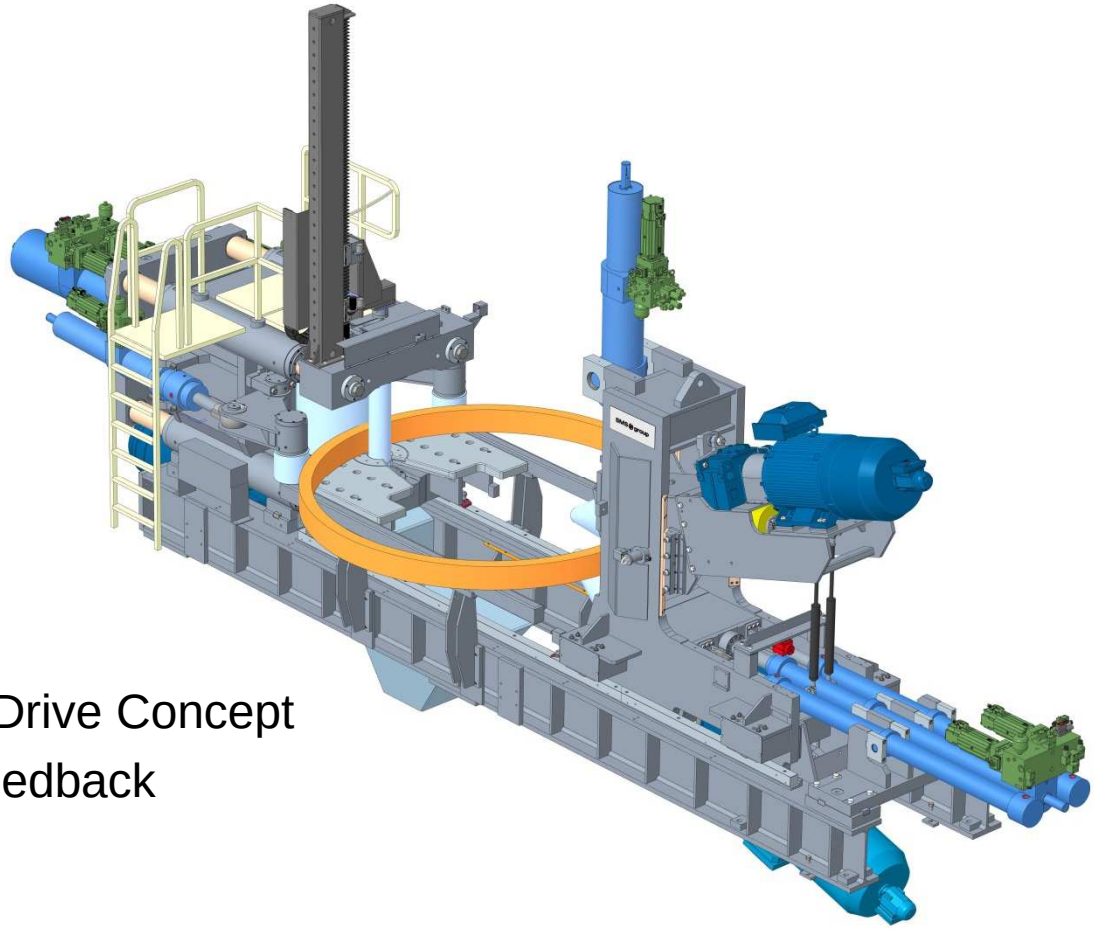
Agenda



- Motivation
- Ringrolling Process
- Electro-Hydrostatic Drive Concept
- First Results and Feedback

Motivation

Bringing together ecology and economy is one of the greatest challenges in the 21st century.

„The most eco-friendly and cheapest kilowatt-hour is the one we don't consume in the first place."

Quote Federal Ministry for Economic Affairs and Energy, BMWi

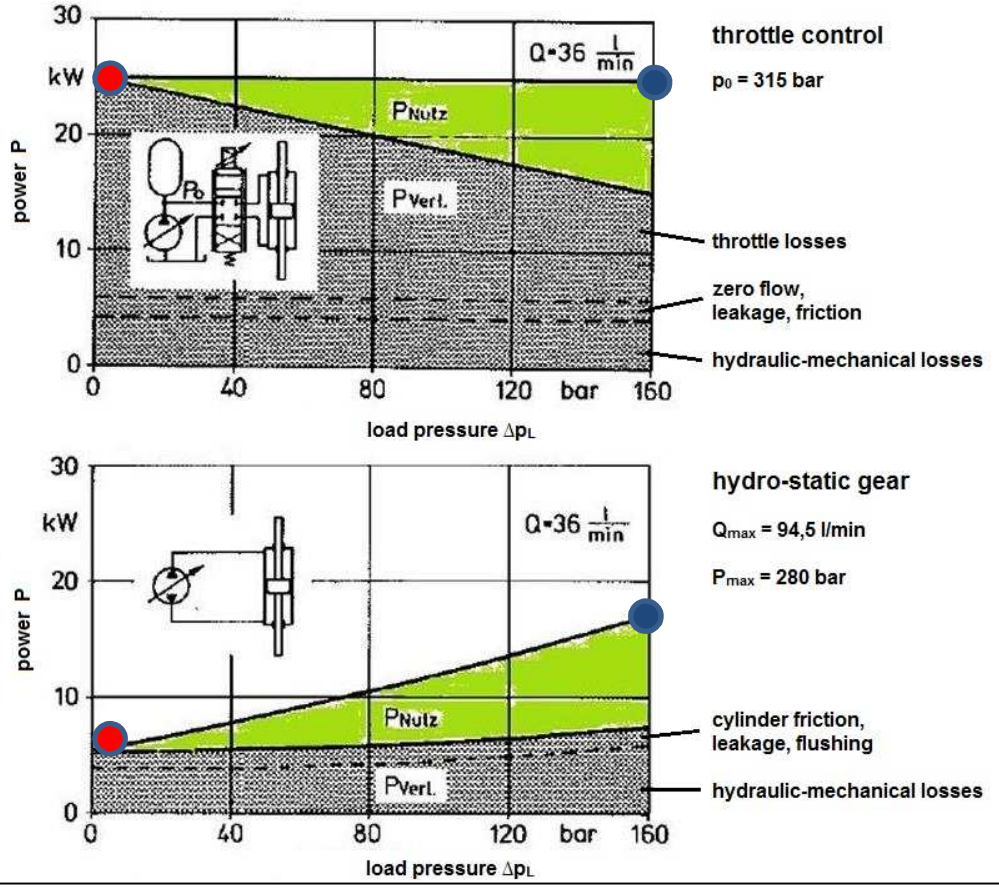
- European Community's ECO Design Directive 2009/32/EC
- German law on the environmentally friendly design of energy-related products (Energieverbrauchsrelevante-Produkte-Gesetz - EVPG)

Comparison of Energy Efficiency

Performance of hydrostatic drives at constant volumetric flow

Energy Savings

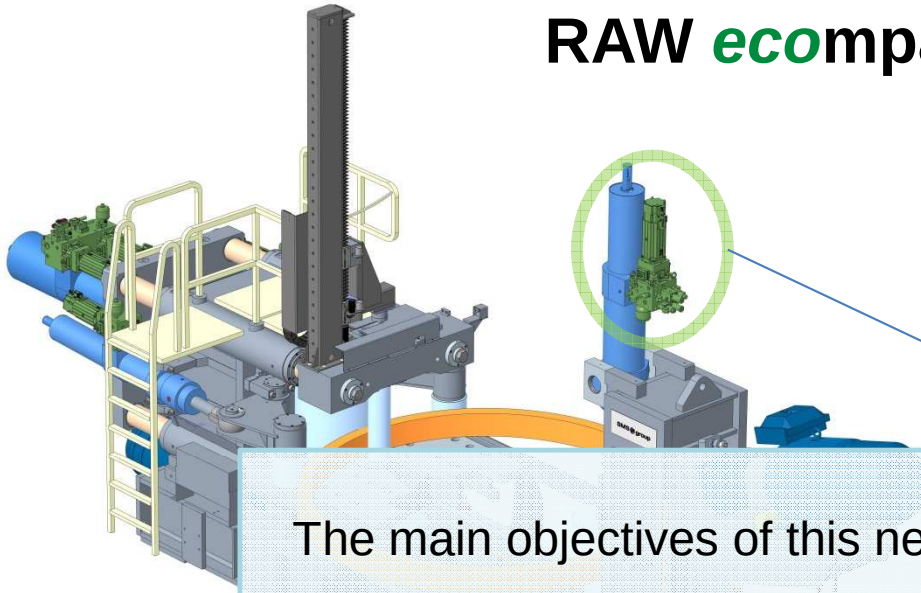
- partial load 75 %
- full load 30 %

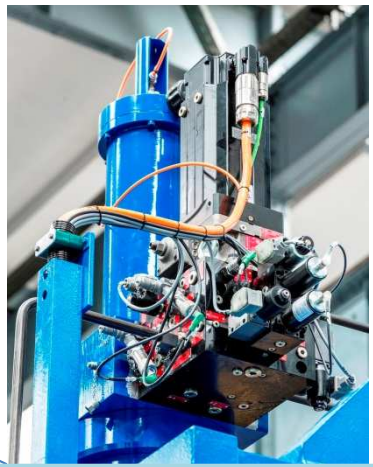


Quelle: Backé, W.; Berbuer, J., Neue Schaltungskonzepte für hydrostatische Getriebe, o+p ölhydraulik und pneumatik 31, (1987), Nr. 6

New Series of Ring Rolling Machines

RAW *eco*mpact





The main objectives of this new development were

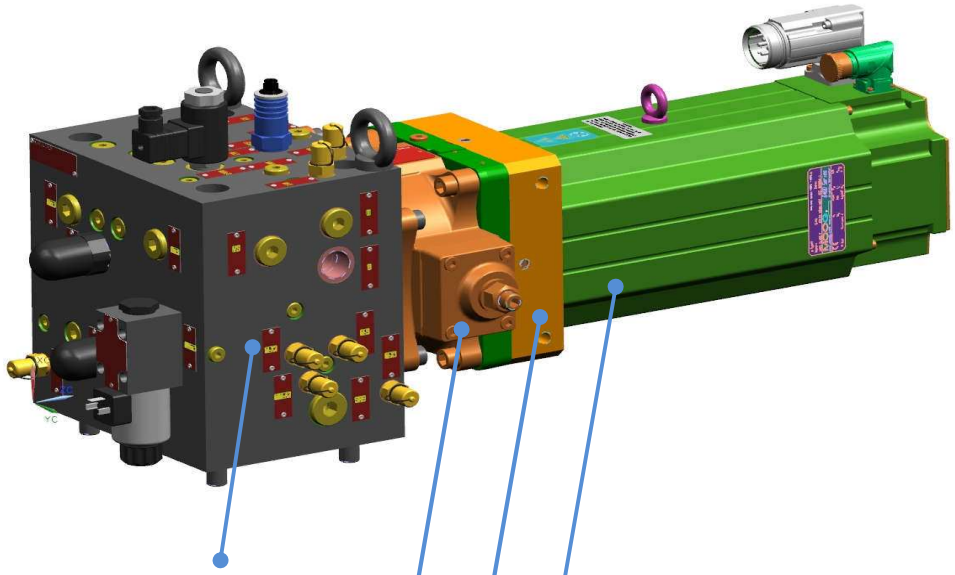
- Increased energy efficiency with process-related widely differing possible working points
- Drastically reduced central hydraulics and pipework in the field
- Cost optimization through reduced assembly and commissioning times
- Built-in condition monitoring

EPU Product Family Moog

Pump Vol. [cm³]	Q max [l/min]	p max [bar]
19	85	350
32	118	350
80	216	350
140	322	350
250	450	350

- Radial Piston Pump (max. pressure 350 bar) with option dual displacement
- Pump design is optimized for 4Q operation, position and speed control
- No limitation for pressure holding
- Defined interface for mounting on manifolds
- Direct motor-pump connection (no rubber or plastic coupling in the drive train)

Electric - Hydraulic Drive Concept

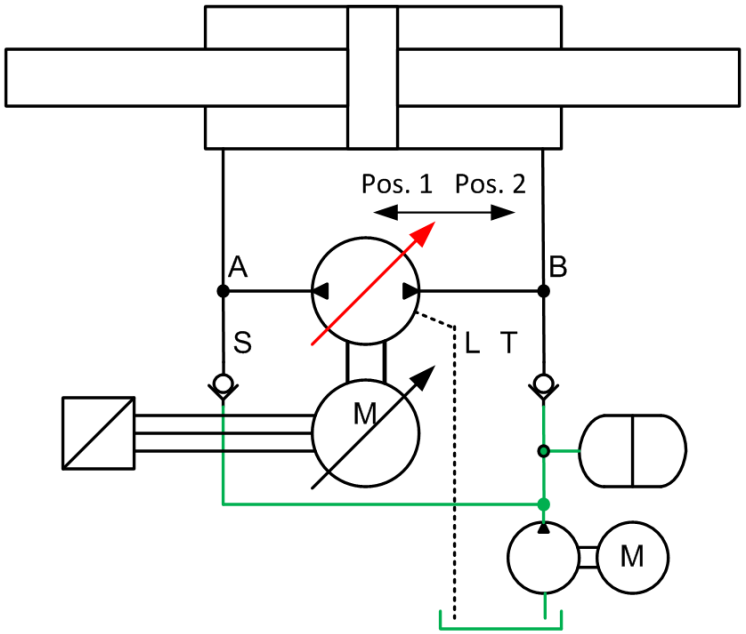


Valve Manifold

Radial Piston Pump

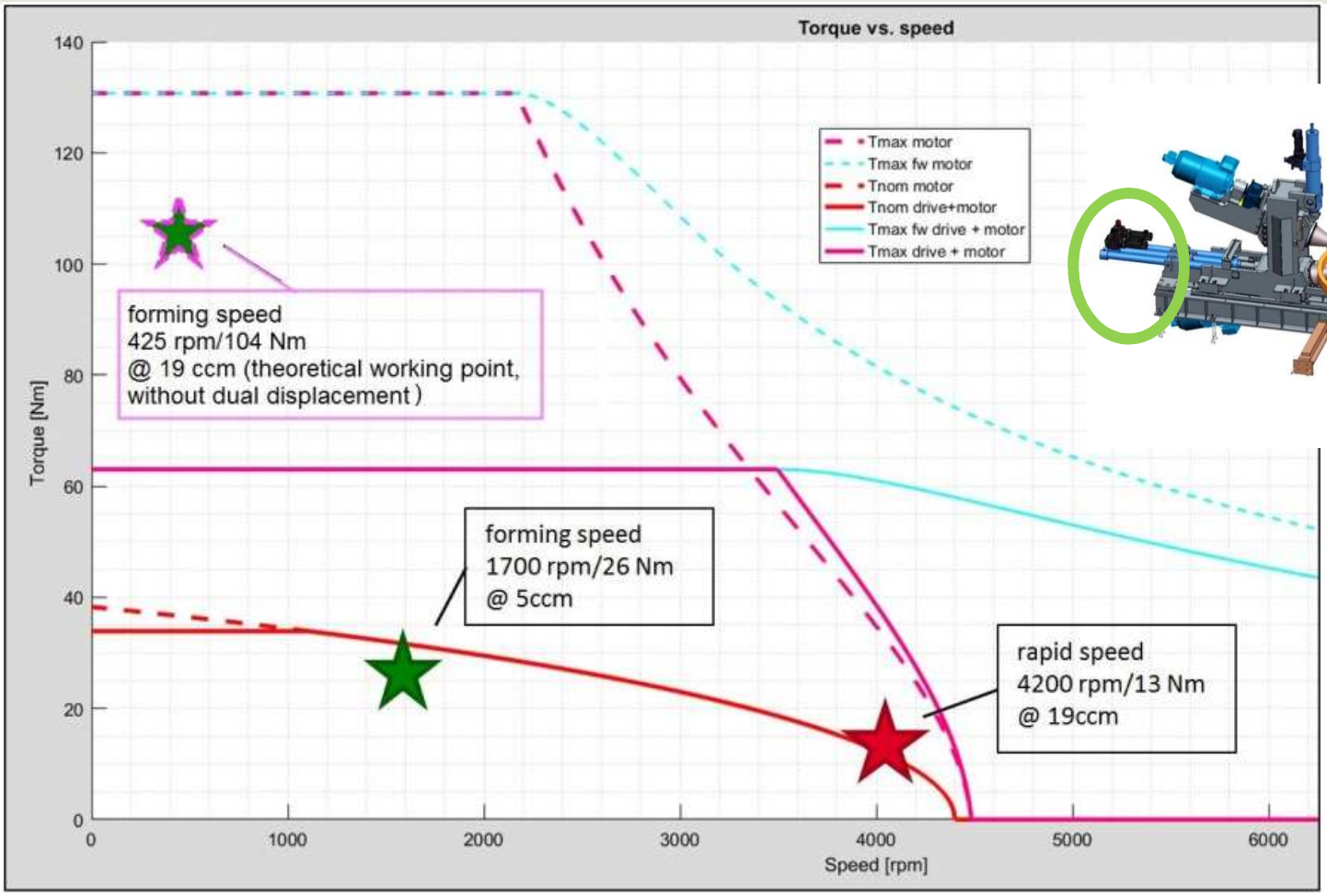
Adapter Flange

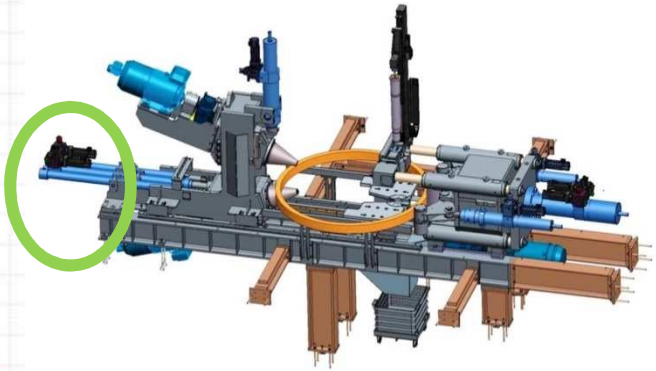
Servomotor



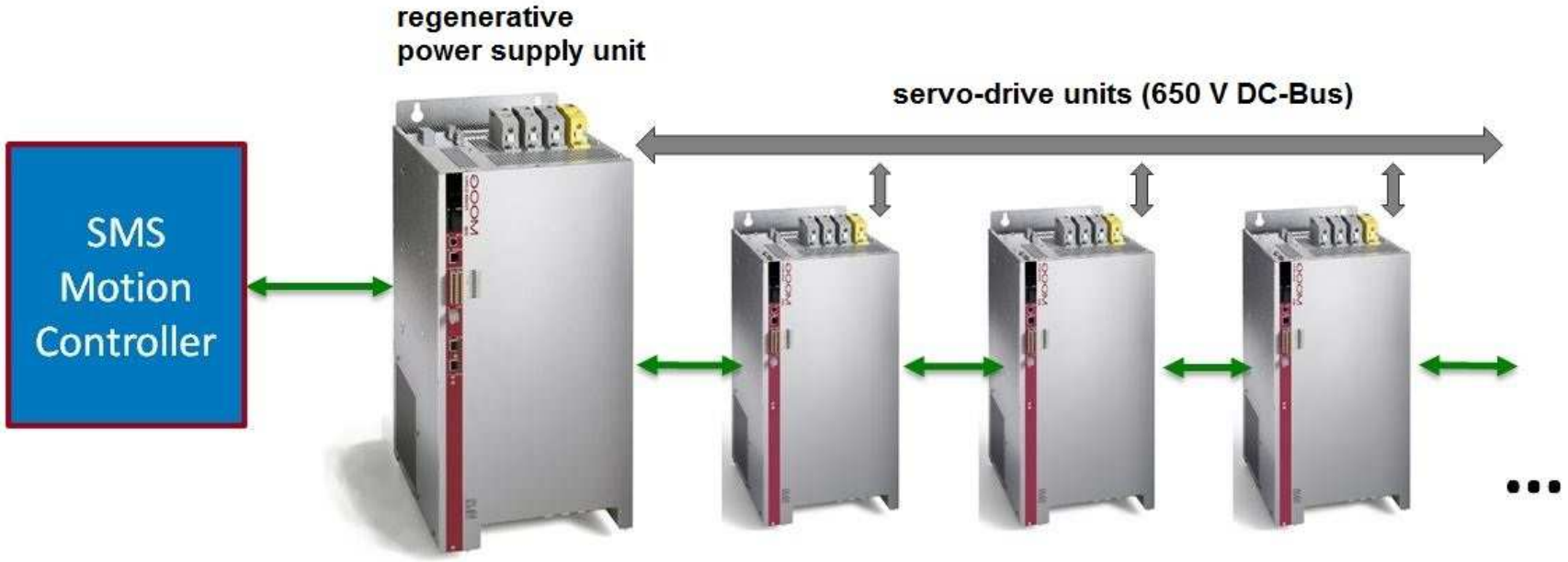
Pump Flow:	Q [l/min]	~	V [cm³] * n [rpm]
Motor Torque:	M [Nm]	~	V [cm³] x p [bar]
Drive Power:	P [kW]	~	Q [l/min] x p [bar]

Typical Working Points of the Drive Unit



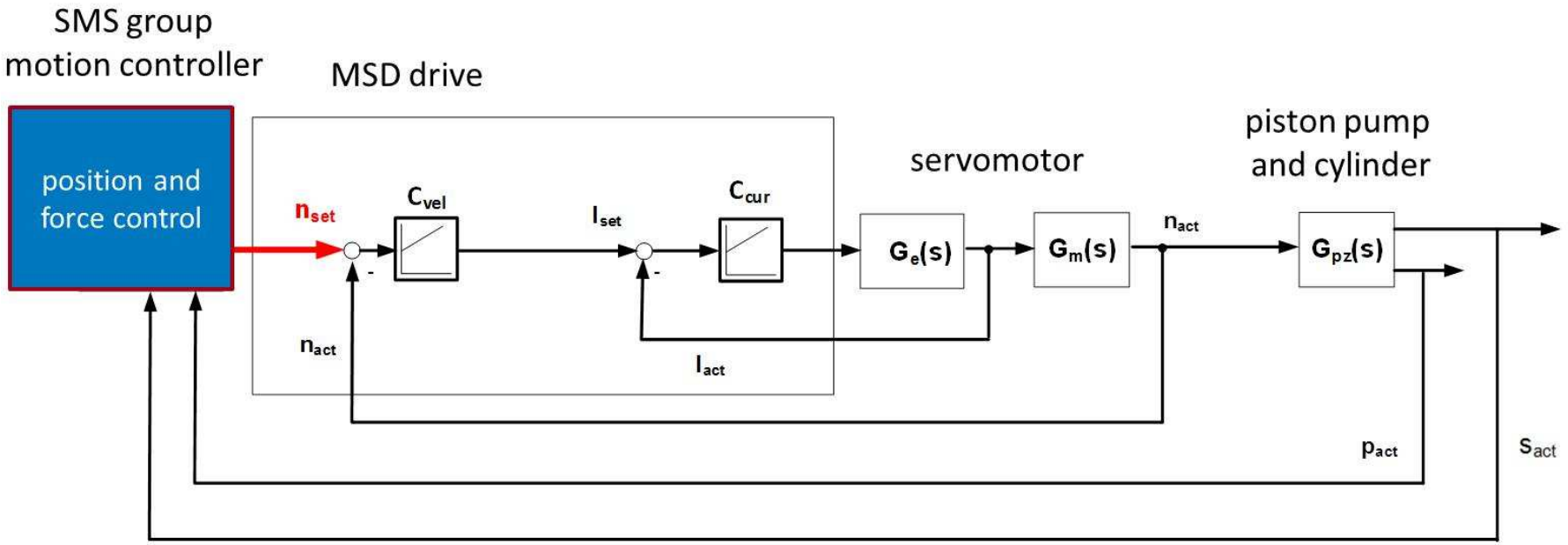


Communication Structure of the Drive System

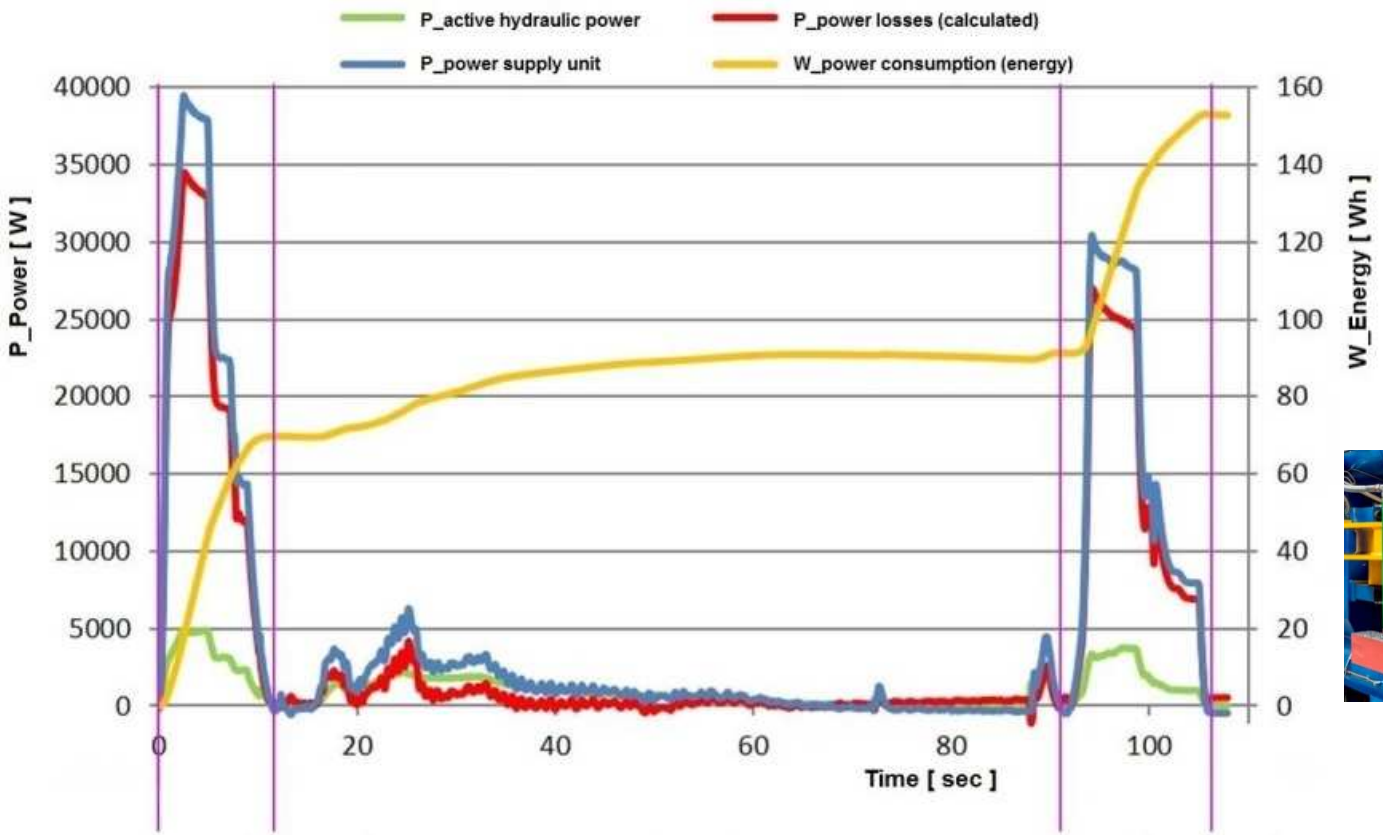


- Regenerative power supply unit
- Servo drives control in 4-Q mode
- Direct power exchange among each other through DC-Bus
- Communication via EtherCAT field bus

Structure of Close-Loop Control



Production Cycle of the Ring Rolling Process

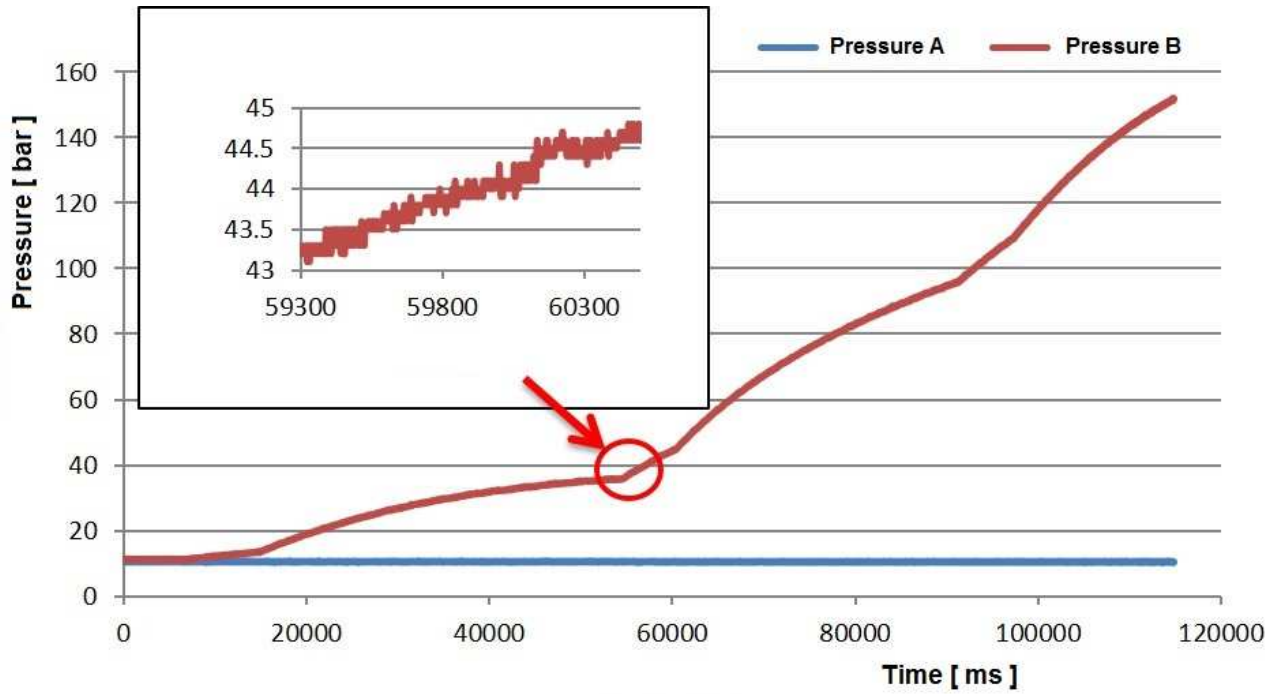


rapid speed to rolling position

ring rolling forming cycle

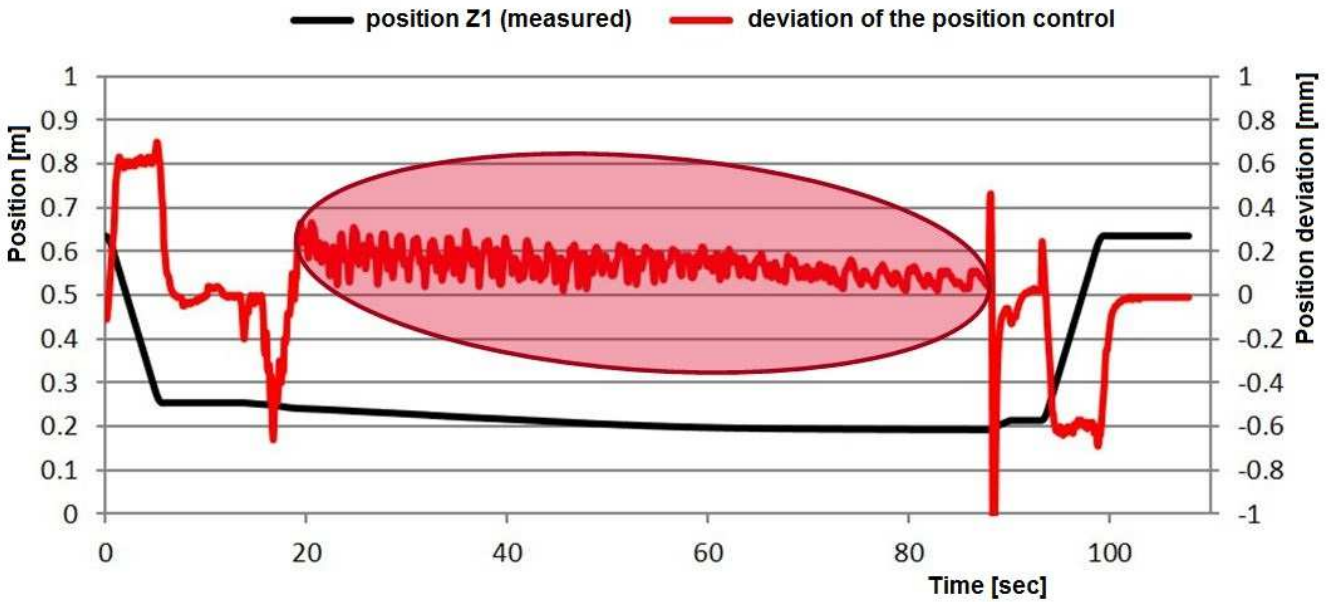
rapid speed to loading position

Pressure Pulsation



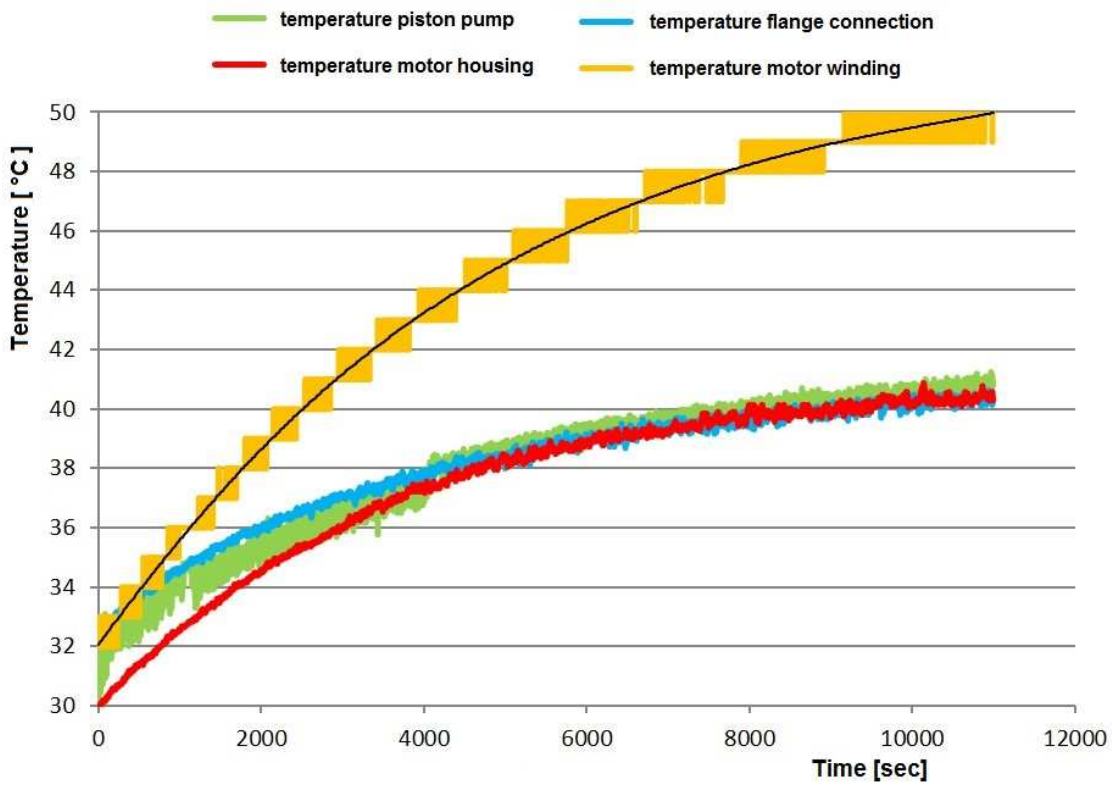
- Pressure pulsation is less then +/- 0.5 bar

Accuracy of the Position Control



- Deviation of the position control during rolling < +/- 0.1 mm
- Deviation of the position control during rapid speed appr. +/- 0.8 mm

Temperature Behavior during Pressure Holding



Pressure holding @

n = 220 1/min

p = 80 bar (M = 7 Nm)

First Experience with the EH Compact Drives

- **Outstanding controllability**
  - of position and force
  - high resolution at very slow motion for forming speed (dual displacement)
  - high speed motion für positioning speed

- **Simple and fault resistant system**
  - reduced number of components
  - no electrical controlled valves
  - minimal piping work and less foundation needs
  - short installation and commissioning times

- **Environment – friendly design**
  - Reduction of the energy consumption up to 70%
  - Reduction of the oil volume up to 80 %
  - Reduction of the noise emission up to 30%

Thank you for your attention!

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