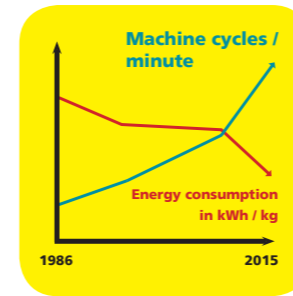


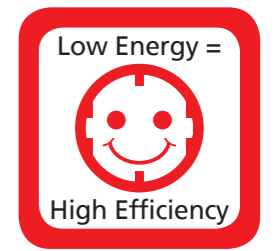
The differences and advantages of the servo-drive technology compared to other technologies ...



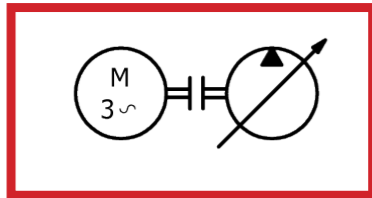
Development of the efficiency of the machines based on the latest drive technologies



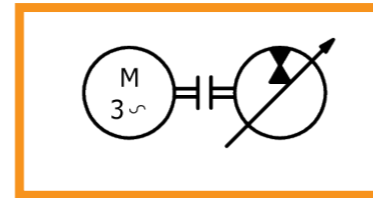
Servo-Drive



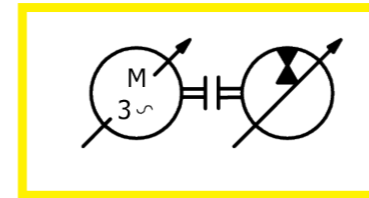
Productivity



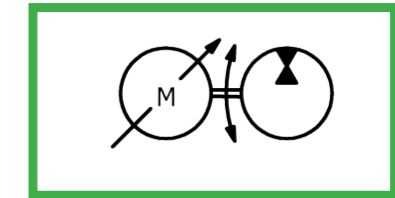
Energy requirement = 100 %



Energy requirement = 87,5 %

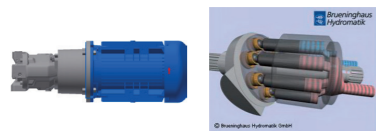


Energy requirement = 70 %



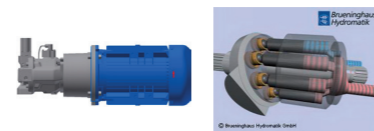
Energy requirement = 45 %

Drive system with hydraulic volume control / variable displacement pumps



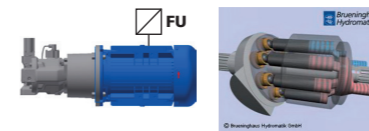
- This drive technology has already been used in the 1980's and was already superseded by a more efficient DFE pump drive unit in 1995.
- The pressure-volume control is carried out by two proportional valves for controlling the pressure and speed.
- Injection moulding machines with this drive technology consume much more energy. This could be determined in numerous comparison tests.
- In addition to greater energy requirement, the cooling capacity required is also significantly larger.
- Due to the high energy requirement, the heat emission of the machine is also larger.
- The oil decays quicker and must be changed more frequently.

Drive system with pressure and volume control by electronically-controlled variable displacement pump (DFE)



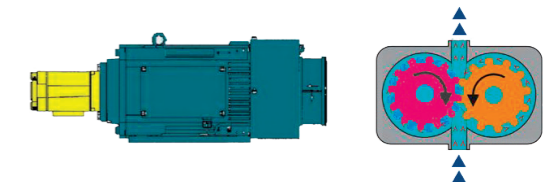
- Variable displacement, controlled by adjustment of the swivel plate. The DFE pump requires approx. 150 ms from being stationary to the top speed.
- If no pump performance is required, the DFE pump switches to a standby mode (idle running). This results in a slower dynamic and, thus, as a consequence, a longer cycle time in comparison to the system with pressure-volume control.
- Due to the energy requirement during the idle mode (pump the idley running mode, however, full speed of the electro-motor with rated speed) the energy consumption is substantially higher compared to a servo-drive system which switches off entirely and consumes no energy at this stage.

Drive system with asynchronous motor with variable displacement pump



- This drive technology is promoted by some competitors under the designation **SERVO**, but has little in common with the technology of a servo motor.
- In addition, these drive systems designated as efficient are often offered at a considerable surcharge.
- Higher energy consumption, lower dynamics are the consequences for the user.
- Due to the lower costs for this technology, the sales price for the machines can be less than for machines with the servo drive technology.
- The interested customer a machine with an „outdated technology“; is offered, basically „aged wine in new tubes“.

Servo-drive

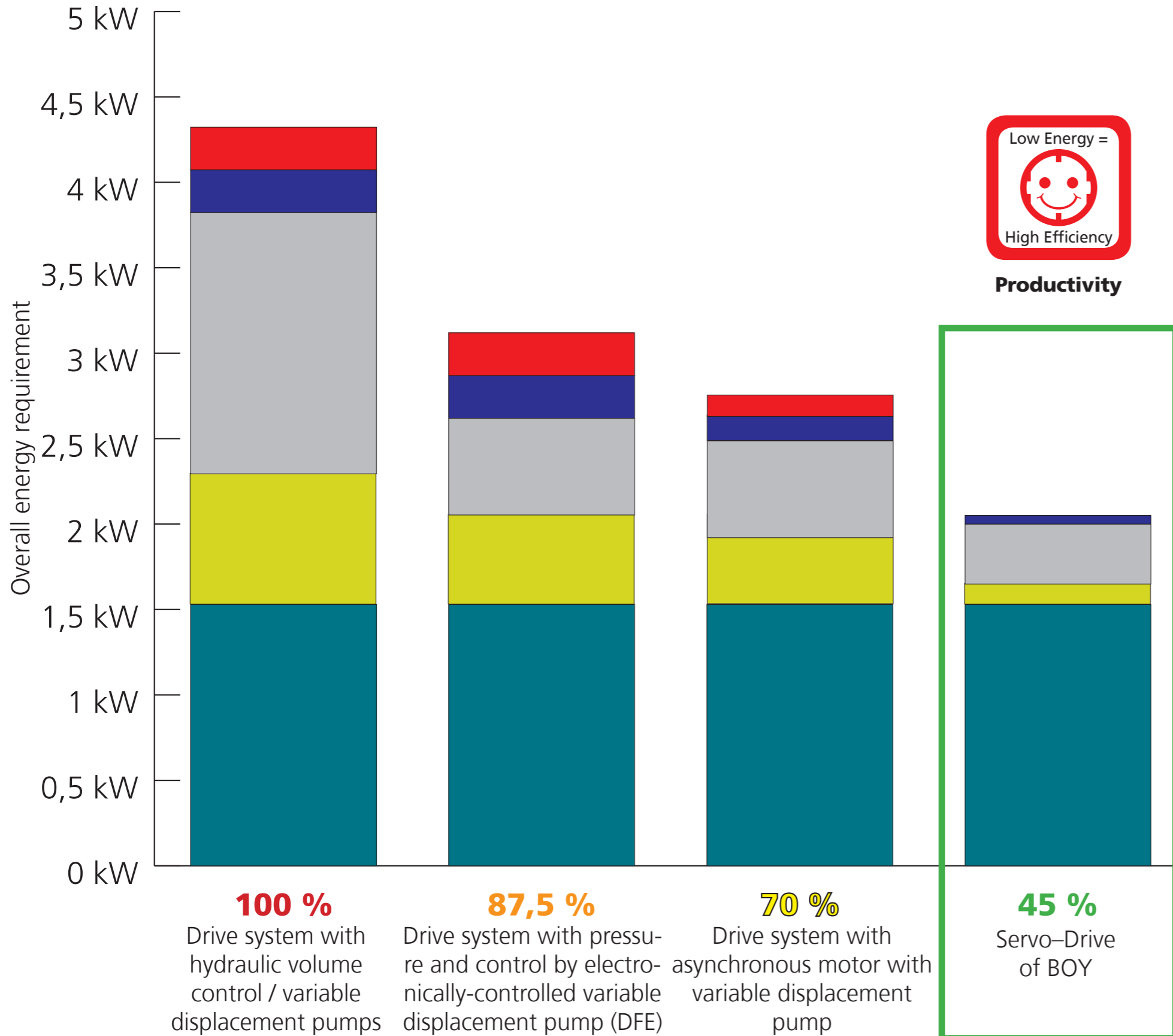


- Constant displacement per revolution. The control is carried out by changing the revolutions. The max. displacement performance is achieved in less than 70 ms from switched off position.
- Higher dynamics without start-up losses for highest accuracy of positioning.
- If no pump performance is required, the pump and the servo motor switch off and consume no energy.
- Energy savings of up to 55 % are possible by the servo-drive system. Less supply of energy means less CO₂ pollution for the environment and less heat generation. Oil cooling is therefore in many cases not required at all.
- One drive unit for all axes requires also one converter only – a potential saving compared to electro-mechanical drives with multiple converters.

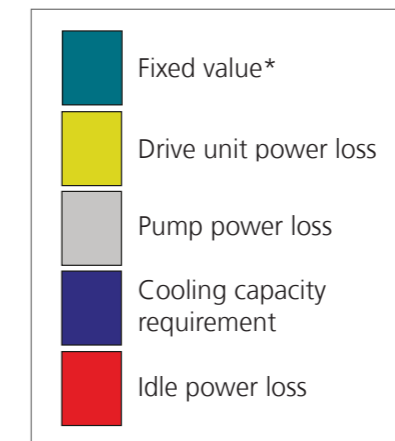
Example of a cycle of a BOY 35 E with a cycle time of 16 s including 4 s cooling time



Spritzgiessautomaten



	Fixed value	Drive unit power loss	Pump power loss	Cooling capacity requirement	Idle power loss
Energy requirement 100 %	1529 W	765 W	1529 W	250 W	250 W
Energy requirement 87,5 %	1529 W	524 W	566 W	250 W	250 W
Energy requirement 70 %	1529 W	424 W	566 W	150 W	100 W
Energy requirement 45 %	1529 W	120 W	351 W	50 W	0 W



*Fixed value: This energy is required in order to heat up the material and carry out movements of the machine.

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The technologies in detail

Drive system with hydraulic volume control / variable displacement pumps (DFR)

The pressure volume control operates exclusively using hydraulic actuating and control elements/ adjustment mechanisms of the pump, the hydraulic piston and hydraulic proportional valves to control the pump adjustment. Thus, the control characteristics are in direct correlation to the oil temperature/viscosity.

approx. 40°C is mandatory.

The system requires approx. 10 - 15 % energy for its inherent control across the complete operating range.

The control repeatability can only function at the same oil temperature/viscosity.

Energy for oil preheating to a set-up value of

Drive system with pressure and volume control by electronically-controlled variable displacement pump (DFE)

The electronically-controlled pressure volume control also has hydraulic actuating and control elements, however, with considerably less power loss. Here, the hydraulic actuating pistons of the pump also require a higher repeatable accuracy in order to attain the required set value. A constant oil temperature/viscosity and oil preheating is also mandatory with this system.

By using electronic sensors (pressure and speed), the power loss is reduced in comparison to the DFR-system.

Drive system with asynchronous motor with variable displacement pump

The reduction of the power loss compared to the DFE is exclusively attained here by using the variable-speed asynchronous motor.

The disadvantage is a complex control technology, because both control circuits (hydraulic DFE pump, electronic frequency converter with asynchronous motor connected to each other via

the controller) must be controlled.

A constant oil temperature is also necessary with this system to attain a constant precision of the control.

Servo-drive system

The closed control circuit of the servo-drive system is exclusively designed using electronic sensors and electronic controllers for the control of the speed and pressure.

As a consequence, this means that the oil temperature can fluctuate within a range of 25°C - 45°C without having a negative influence on the precision of the control.

All control procedures are exclusively carried out by changing the speed of the rotations of the fixed displacement pump.

A set-up-actual comparison in the machine controller transmits all commands to the frequency converter. This calculates the changes in the revolutions required for the synchronous

servo motor (DSM).

The servo drive technology is by far the best drive technology for injection moulding machines. It provides the best conditions for a most precise control of set values.

The environment of the injection moulding machines is significantly improved due to the noise and heat emissions being halved, to the delight of all employees.