

SAI
Hydraulic Motors

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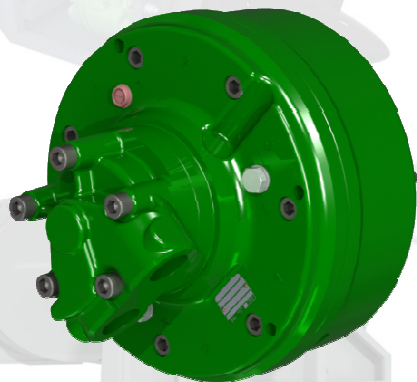
Hydraulic Motors

T series main features

T SERIES

- The motors of the new T series are featured by 7 cylinders to improve power density and performances

- FIXED (TF)**



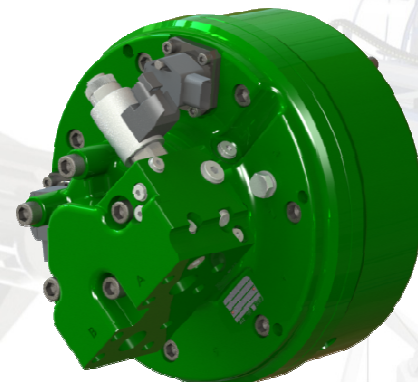
From 240 to 1200 cc/rev
POWER: From 110 to 220 kW
SPEED: From 0,1 to 1200 rpm
PRESSURE: From 350 to 450 bar

- DUAL (TD)**



Min. max. displ. up to 0-1200 cc/rev
POWER: From 110 to 220 kW
SPEED: From 0,1 to 2500 rpm
PRESSURE: From 350 to 450 peak pressure

- VARIABLE (TV)**



Infinite displacement variation from 0 to 1200 cc/rev
POWER: From 110 to 220 kW
SPEED: From 0,1 to 2500 rpm
PRESSURE: From 350 to 450 bar

T SERIES FEATURES

- High power density + high bearing lifetime
- Higher torque stability with the 7 pistons design
- High displacement variation (ratio used up to 1:10)
- High efficiency even at low displacement
- Possibility to reach 0 cc/rev
- Very easy freewheeling at zero displacement



T SERIES IMPROVEMENT

POWER DENSITY RANGE (KW)

1.5



Peak power in max. displ.: 110 kW
Peak power in min. displ.: 80 kW

2.5



Peak power in max. displ.: 140 kW
Peak power in min. displ.: 100 kW

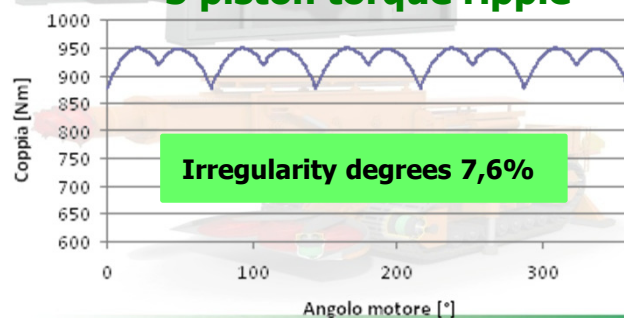
3.5



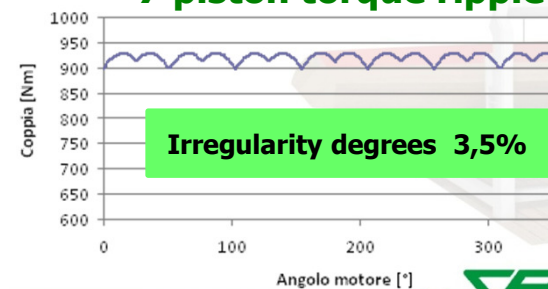
Peak power in max. displ.: 220 kW
Peak power in min. displ.: 180 kW

INCREASED TORQUE STABILITY 240 BAR DELTA PRESSURE IN A 250 CC/REV

5 piston torque ripple



7 piston torque ripple



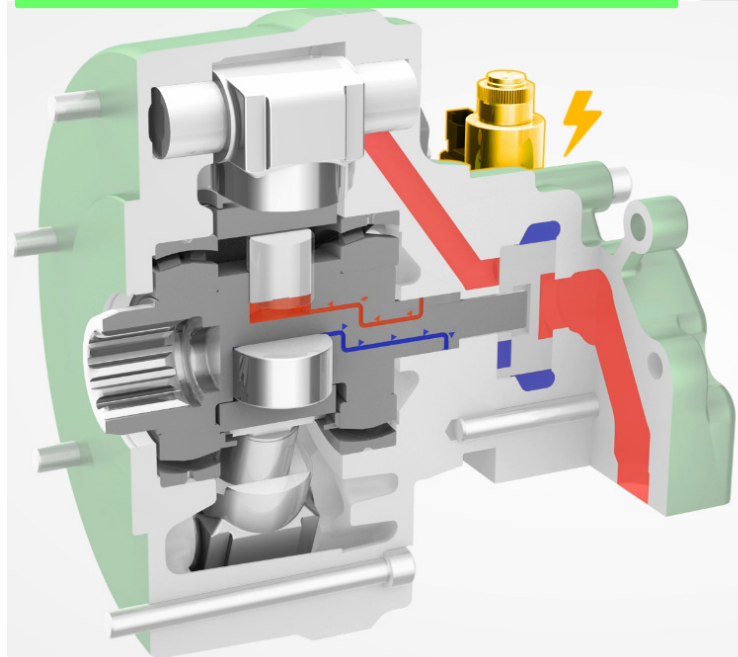
DISPLACEMENT VARIATION

The displacement depends on :

Bore of cylinder (d)
n° of cylinders (nc)
Stroke of piston (c)

Displacement =

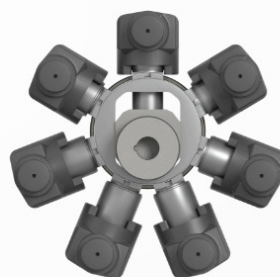
$$\frac{d^2}{2} * \pi * nc * e$$



Motor displacement



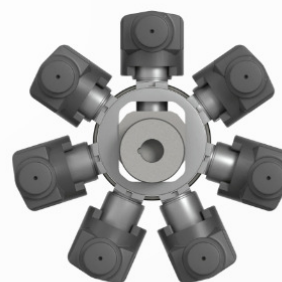
100%



Motor displacement



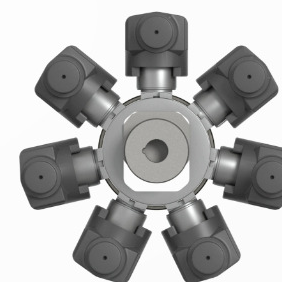
50%



Motor displacement



0%





Hydraulic Motors

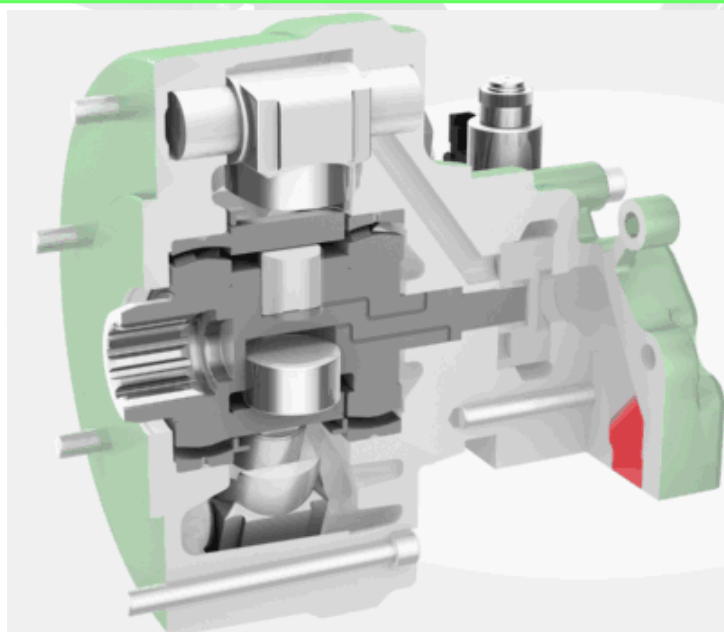
DISPLACEMENT VARIATION CONTROL

Ways to control the displacement:

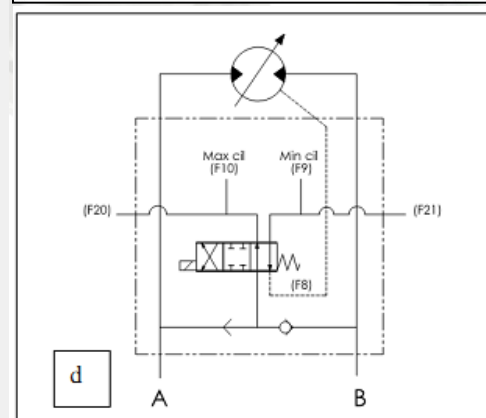
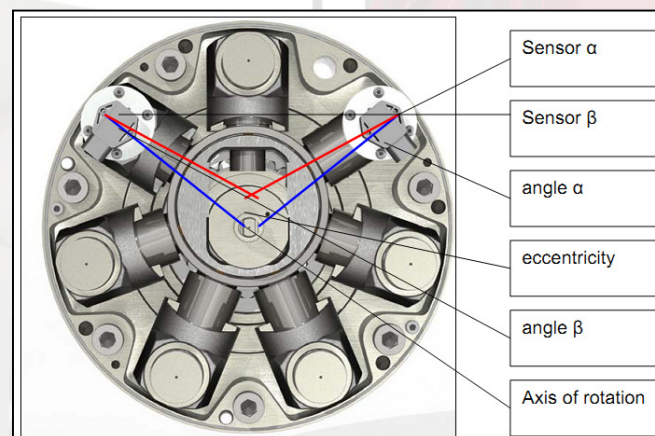
DUAL DISPLACEMENT: hydraulic or electric

VARIABLE DISPLACEMENT: electric + CPU + angular sensor

COSTANT PRESSURE: self adjusting system (READY SOON)



Motor displacement



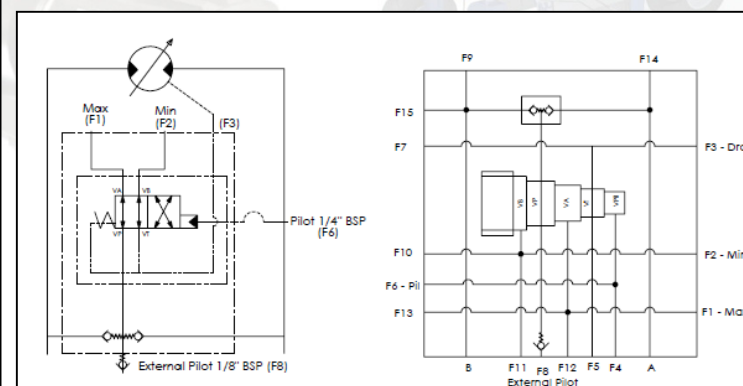
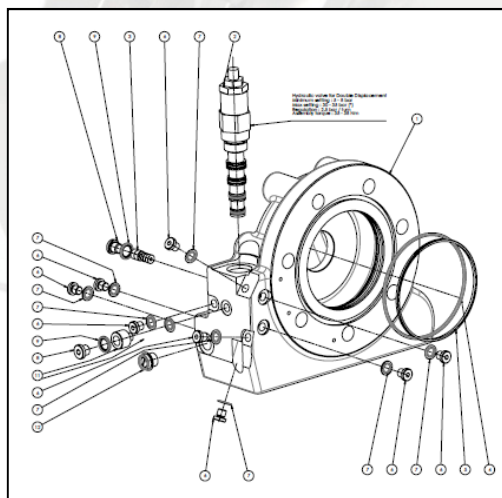
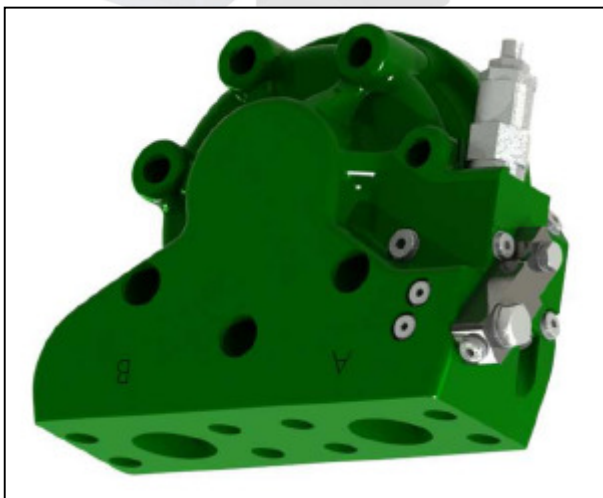
DISPLACEMENT VARIATION CONTROL

DISTRIBUTOR WITH INTEGRATED HYDRAULIC CIRCUIT:

- **DUAL DISPLACEMENT:** hydraulic or electric + override (only electric)
- **VARIABLE DISPLACEMENT:** electric + CPU + angular sensor
- **COSTANT PRESSURE:** self adjusting system (READY SOON)

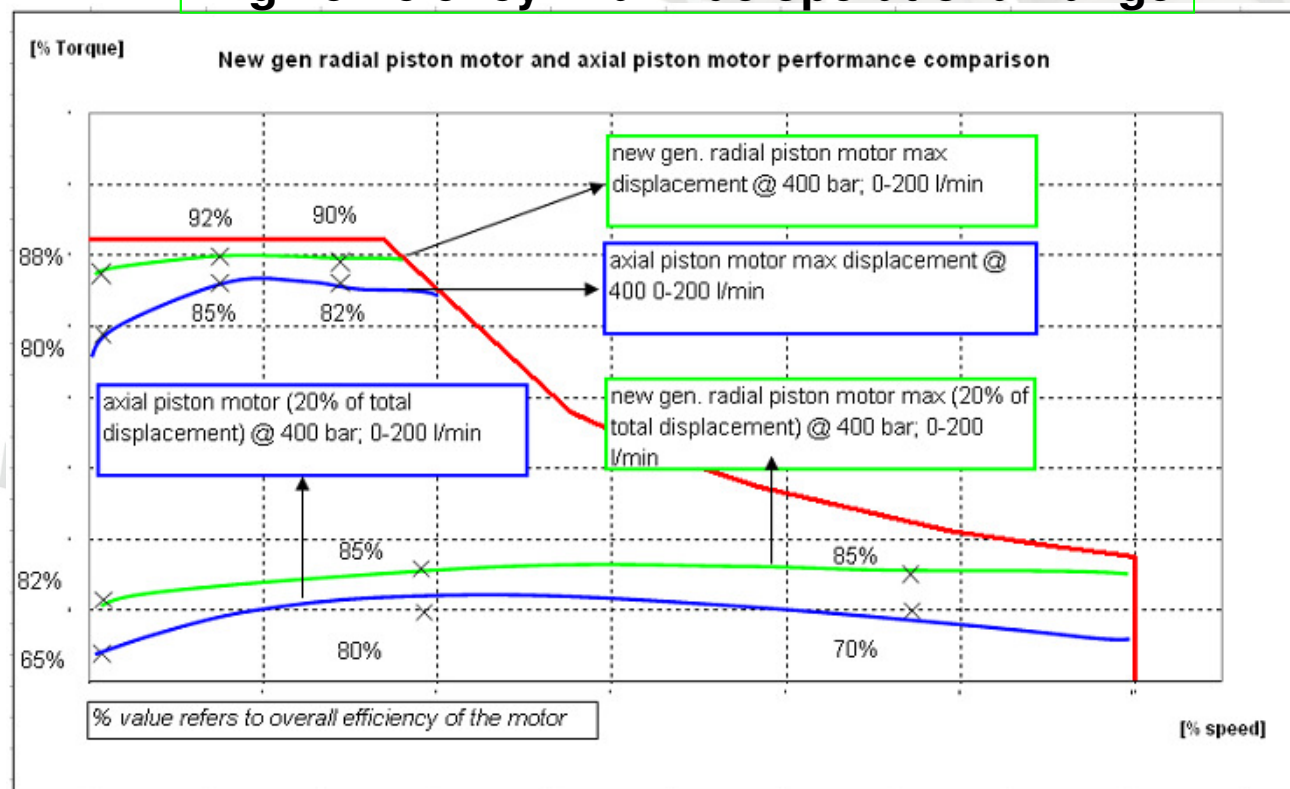
FEATURES TO SET :

- **fast or low shifting time** (orifices that can be regulated from the distributor)
- **extremely fast response with extra high pressure line** that can be connected to the distributor
- **Override** (only for electric valve)



MAIN FEATURES OF VARIABLE DISPLACEMENT CRANKSHAFT DESIGN HYDRAULIC MOTORS

High efficiency in a wide operational range



Comparison between a new generation radial piston motor and an axial piston one when working at the same power conditions

- 1) Smooth transmission
- 2) Wide operational range
- 3) High efficiency

MAIN FEATURES OF VARIABLE DISPLACEMENT CRANKSHAFT DESIGN HYDRAULIC MOTORS

Freewheeling at zero displacement without any extra power needed



no extra pressure needed to keep the motor at zero cc/rev or for lubrication

Motor disconnected from hydraulic circuit

No speed limit (no extra pressure needed to keep the motor at zero cc/rev or for lubrication)

No power losses (only few Nm of torque absorbed)

No extra flushing needed

EFFICIENCY COMPARISON: TV1.5 VS AN AXIAL PISTON MOTOR

TEST CONDITIONS

Dynamometric brake

Hydraulic motor maximum power (fixed: 100 kW)

Ambient temperature 20°

Oil temperature 50°

Hydraulic oil: ISO VG 46

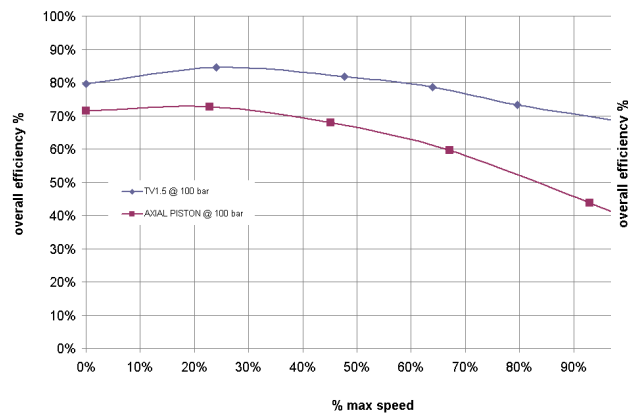
Hydraulic circuit: open loop circuit

- Working pressure: 100 Bar- 200 Bar- 300 400 bar; Flow rate: 0-250 l/min
- TV1.5 working displacement: 216cc\rev – 108 cc\rev - 54cc\rev
- Axial piston working displacement: 80cc\rev - 40cc\rev - 20cc\rev

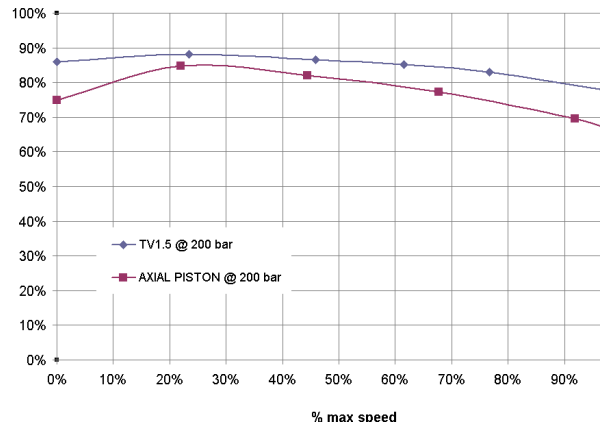
EFFICIENCY COMPARISON: TV1.5 VS AN AXIAL PISTON MOTOR

100% of the total displacement @ 100-200-400 bar

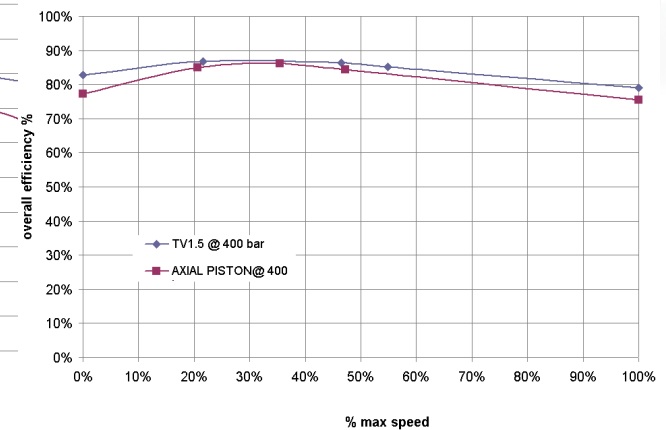
COMPARISON TV1.5 - AXIAL PISTON MOTOR
100% MAX DISPLACEMENT



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COMPARISON TV1.5 - AXIAL PISTON
100% MAX DISPLACEMENT

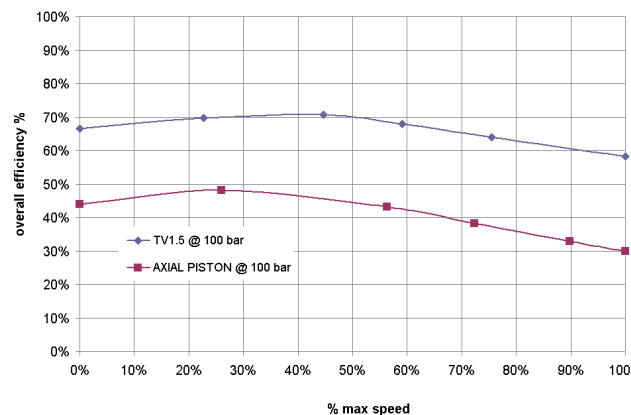


Value referred to the overall efficiency of the motors

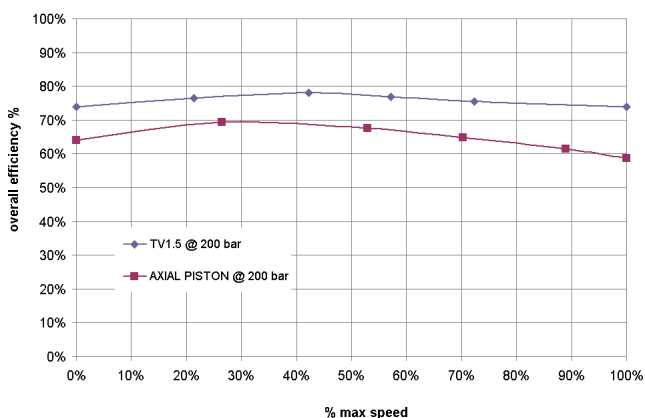
EFFICIENCY COMPARISON: TV1.5 VS AN AXIAL PISTON MOTOR 50% OF THE TOTAL DISPLACEMENT

50% of total displacement @ 100-200-300 bar

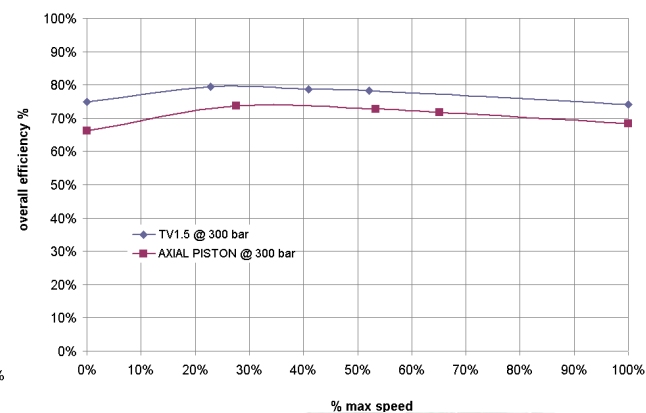
COMPARISON TV1.5 - AXIAL PISTON
50% MAX DISPLACEMENT



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COMPARISON TV1.5 - AXIAL PISTON
50% MAX DISPLACEMENT

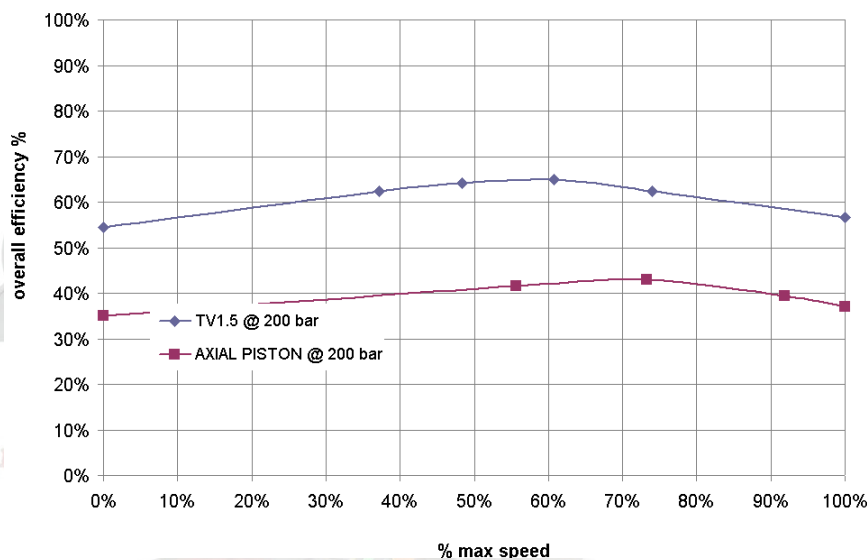


Value referred to the overall efficiency of the motors

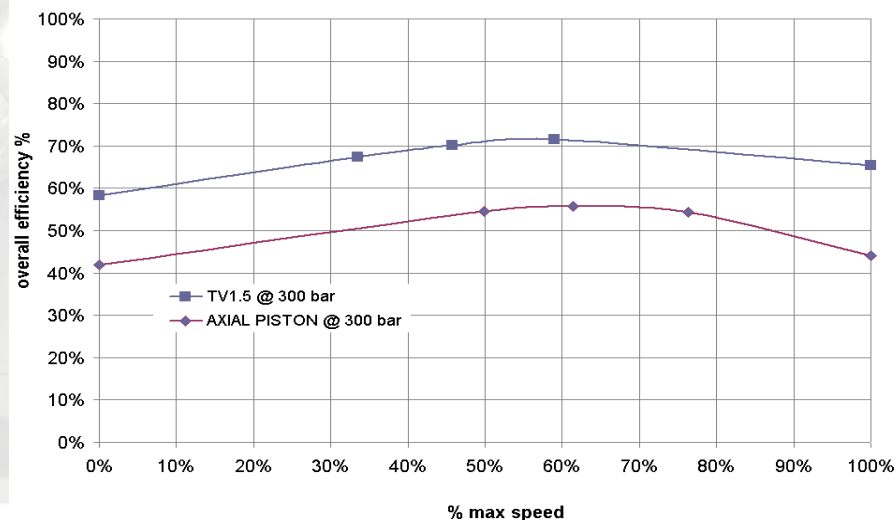
EFFICIENCY COMPARISON: TV1.5 VS AN AXIAL PISTON MOTOR 25% OF THE TOTAL DISPLACEMENT

25% of the total displacement @ 200-300 bar

COMPARISON TV1.5 - AXIAL PISTON
25% MAX DISPLACEMENT



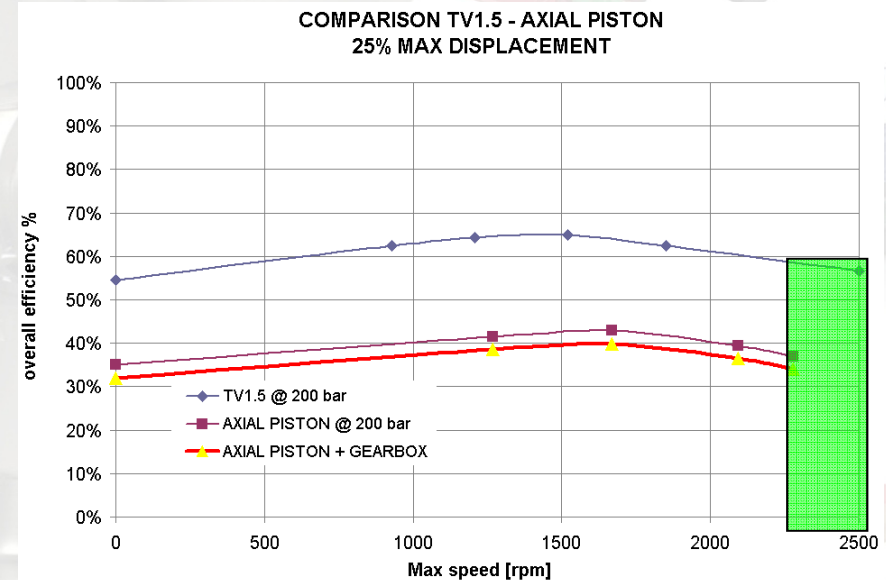
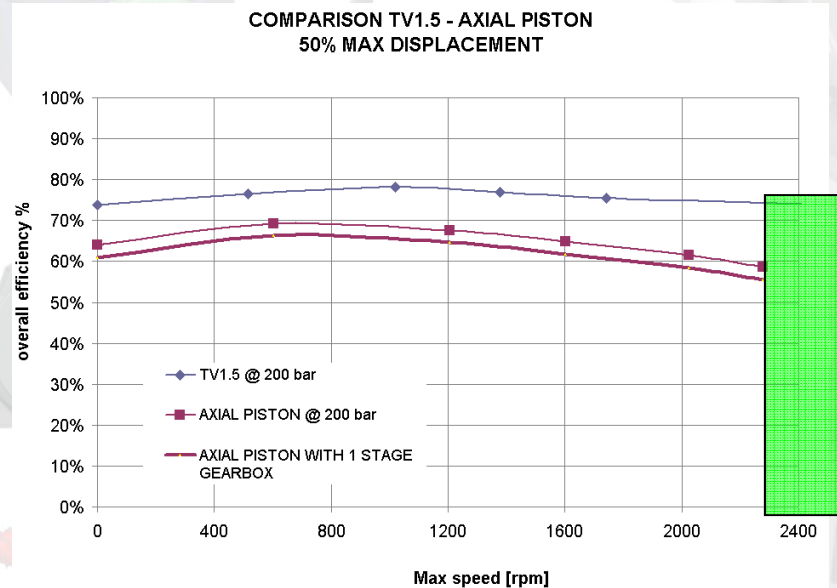
COMPARISON TV1.5 - AXIAL PISTON
25% MAX DISPLACEMENT



Value referred to the overall efficiency of the motors

EFFICIENCY COMPARISON:

TV1.5 VS AN AXIAL PISTON MOTOR CONSIDERING 1 STAGE OF REDUCTION (2.7:1) 50% & 25% OF THE TOTAL DISPLACEMENT @ 200 BAR



Speed range area only with SAI solution

Value referred to the overall efficiency of the motors

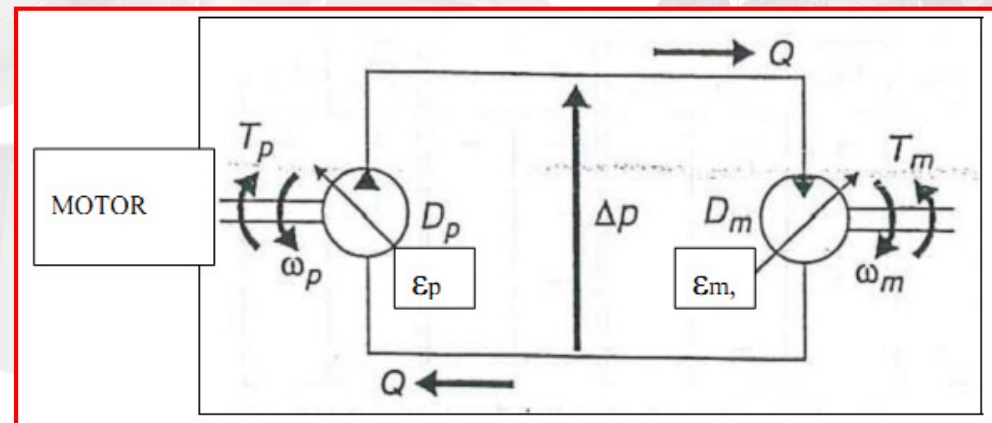
ADVANTAGES OF HIGH RANGE OF DISPLACEMENT VARIATION AND HIGH EFFICIENCY

- An hydrostatic transmission is a drive or transmission system that uses pressurized hydraulic fluid to drive hydraulic machinery.
- An hydraulic drive system consists of three basic parts:

Electric motor or engine

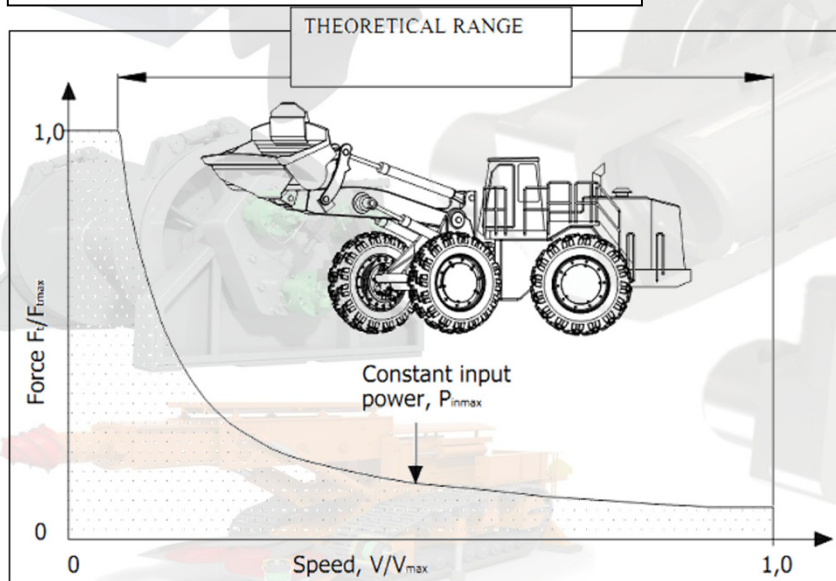
Hydraulic pump

Hydraulic motor



ADVANTAGES OF HIGH RANGE VARIATION

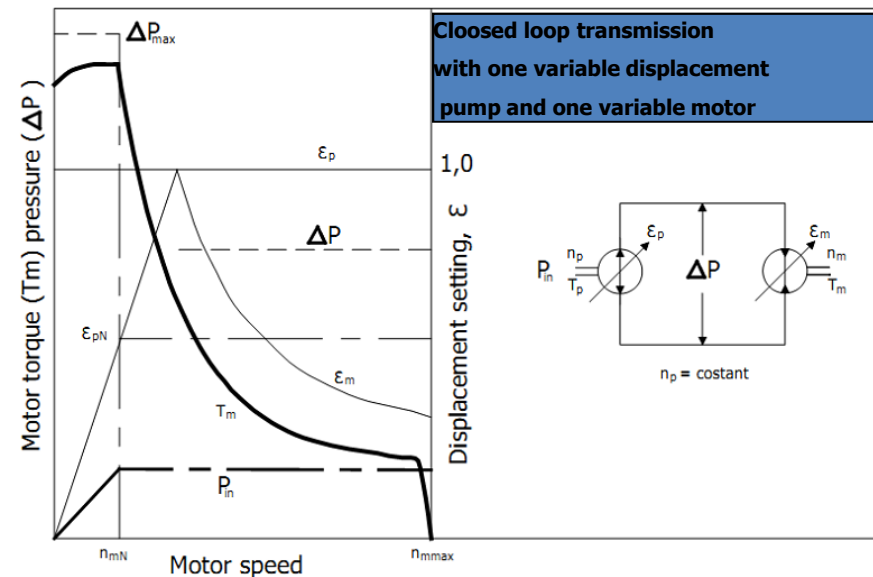
$$TR = \frac{n_{mMax}}{n_{mN}} = \frac{1}{\epsilon_{pN} \epsilon_{mmin}}$$



Swash-plate: $0.30 \leq \epsilon_{mmin} \leq 0.35$

Bent-axis motor: $0.20 \leq \epsilon_{mmin} \leq 0.25$

New generation radial piston motor $0.10 \leq \epsilon_{mmin} \leq 0.20$



ADVANTAGES OF HIGH RANGE VARIATION

Motor type	$\varepsilon_{m \min}$ (maximum)	$\varepsilon_{m \min}$ (minimum)	$\varepsilon_{m \min}$ (average)
Swash plate	0.3	0.35	0.325
Bent axis	0.2	0.25	0.225
New generation radial piston	0.1	0.2	0.15

	With respect to:	
	Swash plate	Bent axis
TR increase with new generation radial piston motor		
Average	+216%	+50%
Max	+300%	+200%

$$TR = \frac{n_{mMax}}{n_{mN}} = \frac{1}{\varepsilon_{pN} \varepsilon_{m \min}}$$

With the use of a radial piston motor the TR-value can increase up to 300% compared to a swash plate motor and up to 200% compared to a bent-axis motor.

Moreover a radial piston motor has a considerably higher efficiency at the start up, respect to swash plate or bent axis and more important the overall efficiency of the motor in low displacement is drastically higher than the axial piston one.

ADVANTAGES OF HIGH RANGE VARIATION IN SOME APPLICATIONS

DRILLING :

Rotary Head with no gear switch for the spin - off and definitely better efficiency of the system

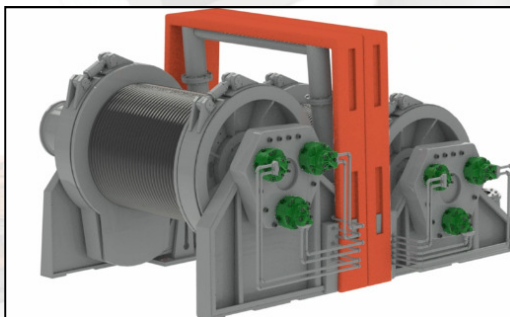


MOBILE :

Dual Displacement motor mounted on the drive axle: high starting torque + high speed no gear change

AGRICULTURE :

Variable Displacement motor mounted on the drive axle: high starting torque + high speed no gear change + fixed motor on the cutting tool



MARINE :

Variable displacement motor with minimum displacement down to zero



A collage of various hydraulic equipment in the background, including a red truck, a blue forklift, a yellow excavator, and a large hydraulic motor.

SAL

Hydraulic Motors

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