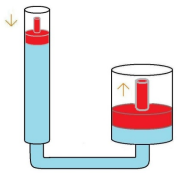
COMPU-SPREAD®



hydraulic design, fundamentals, and diagnosis; September, 2019

TRUCK & TRAILER Specialties, Inc.

rexroth A Bosch Company

Compu-Spread Snow and Ice Solutions

A10V..O load sensing hydraulic pumps

Ideal for energy efficient, closed-center, load sense systems
Compact swashplate piston design:

- High power to weight ratio
- Short controller response times
- Excellent inlet characteristics
- Low noise level
- Long service life

2 case drain ports standard
Many sizes; most common: 45 (2.7 in^3), 60 (3.7 in^3), 74 (4.5 in^3), 85 (5.2 in^3), 100 (6.1 in^3)/rev. displacement

- 21 to 47 USGPM @ 1,800 rpm

SAE standard mounting for front mounted & PTO mount
DFR1 controller = pressure compensator + load sense (signal bleed required) * C-S norm as the M4 valve has the integral bleed
DFR controller = pressure compensator + load sense (signal bleed built into the controller)

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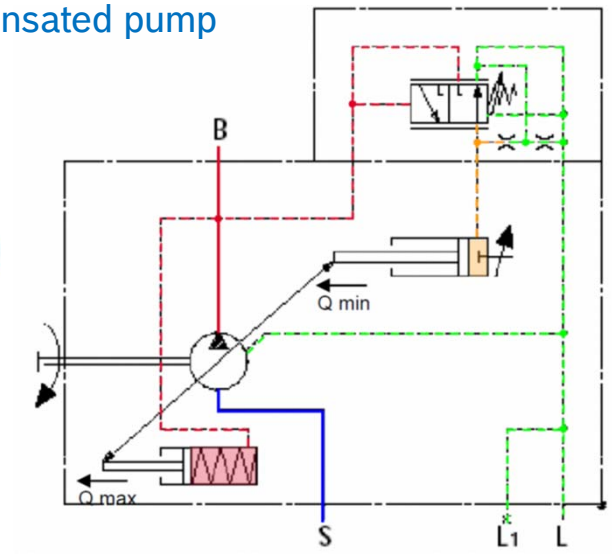
A10VO...pressure compensated pump



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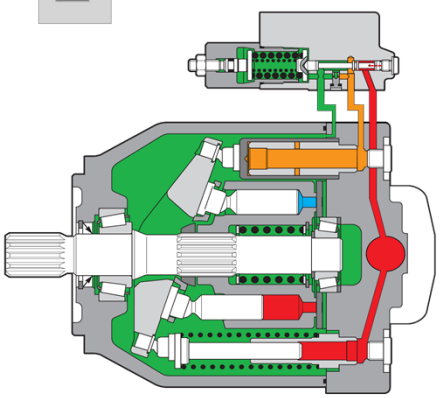
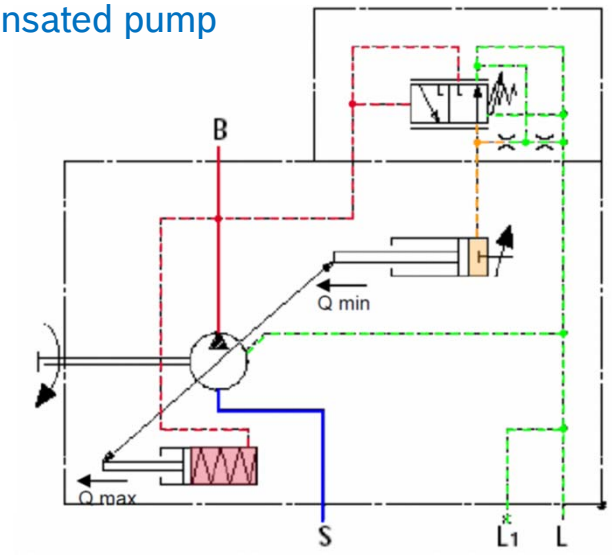
A10VO...pressure compensated pump





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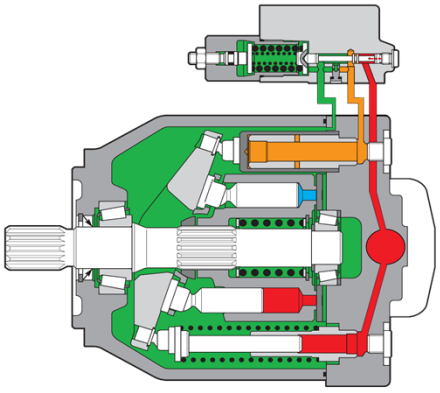
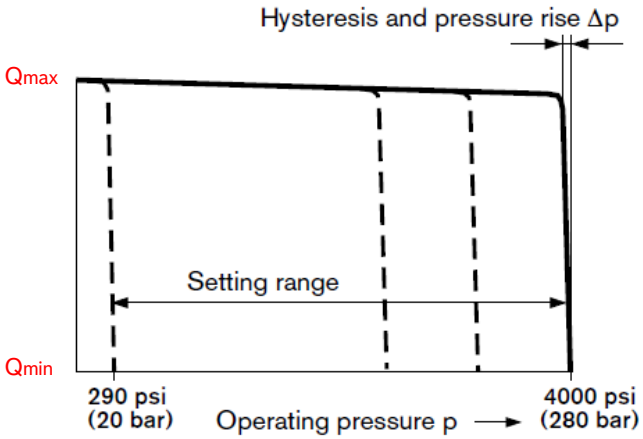
A10VO...pressure compensated pump





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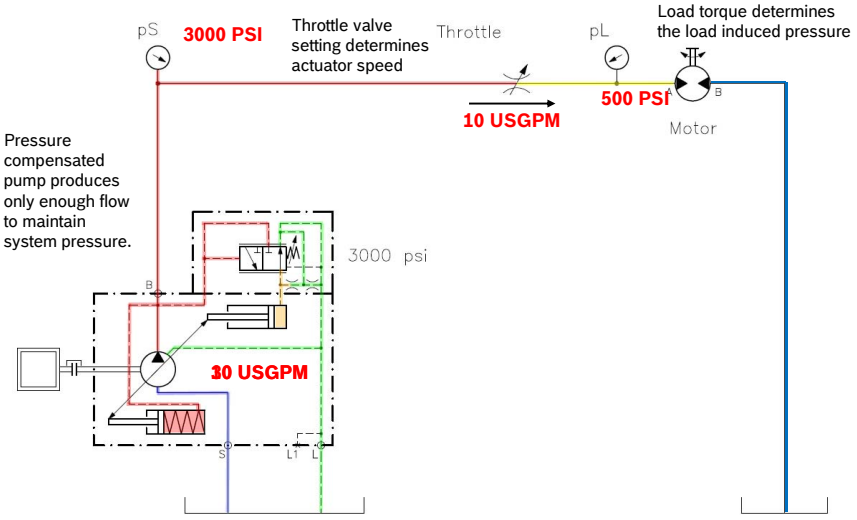
Pressure Compensated Pumps



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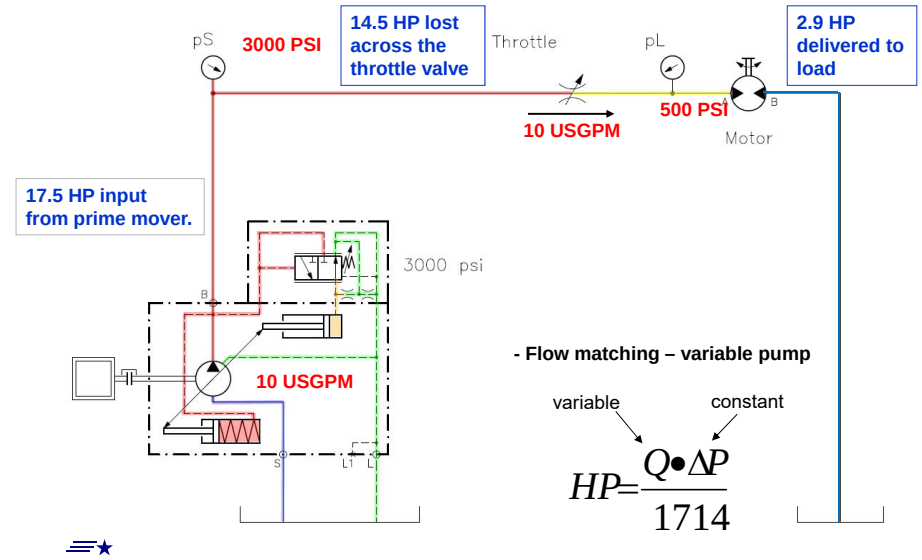
Pressure Compensated Pumps: power distribution



- Flow matching – variable pump

variable constant

$$HP = \frac{Q \bullet \Delta P}{1714}$$

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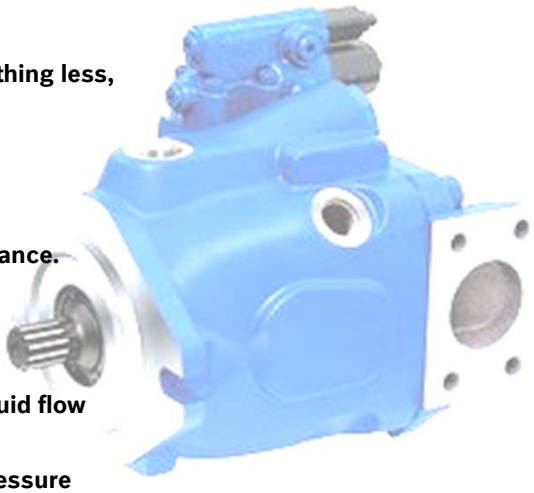
Quick overview of principles of hydraulics

- **Pumps produce flow (Q), nothing more, nothing less, based on RPM x displacement (V_g).**
- **Pressure is resistance to flow.**
- **Oil is lazy and takes the path of least resistance.**
- **Resistances in series are additive**
- **Actuator speed is a function of hydraulic fluid flow**
- **Actuator force is a function of hydraulic pressure**



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Load Sensing Concepts

It is this principle of hydraulics, that "**Resistances in series are additive**", that allow us to even use Load Sensing in our hydraulic systems.

Resistance is an opposing force, that is, to act against something, and can be found in various forms. In Load Sensing systems, we use two types of resistances:

1. Mechanical, which in our case is an adjustable spring (R1),
2. Fluidic, which in our case is a load induced pressure signal (R2)

$$R_{total} = R_1 + R_2$$

Remembering this fact helps us in our understanding and ability to troubleshoot Load Sensing systems.

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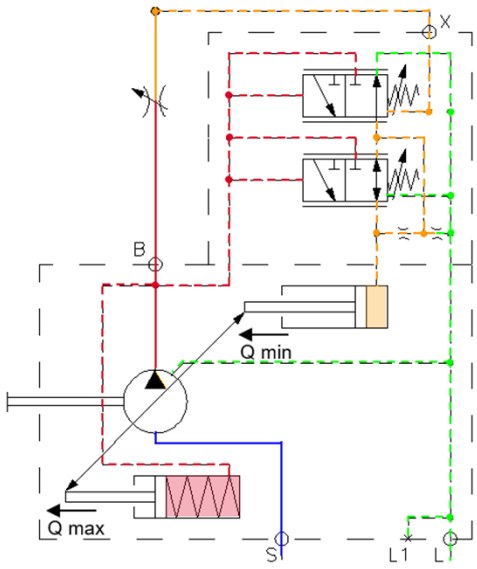
A10VO ... load sensing pump



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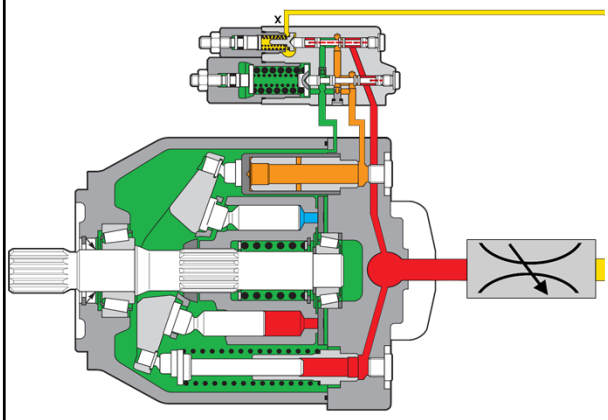
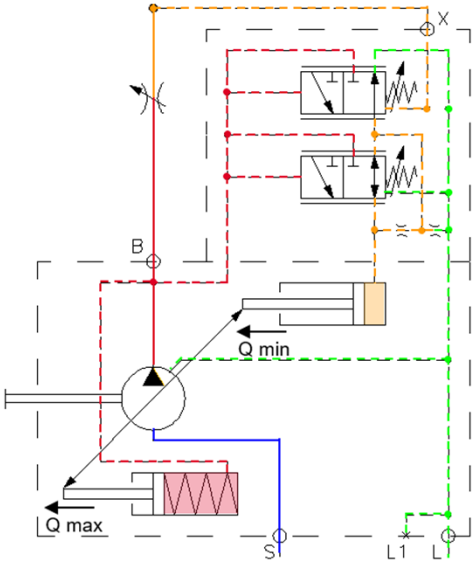
A10VO ... load sensing pump





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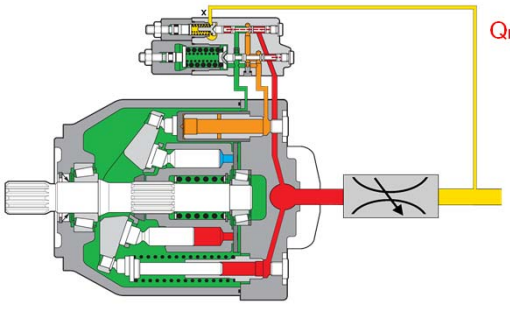
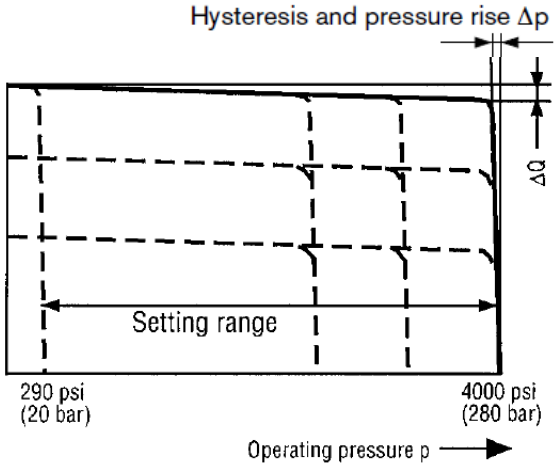
A10VO ... load sensing pump





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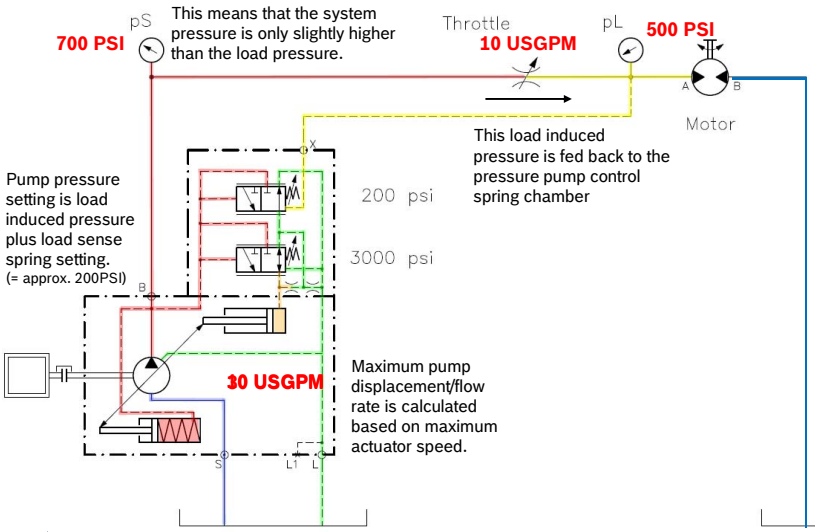
Load Sensing Pumps



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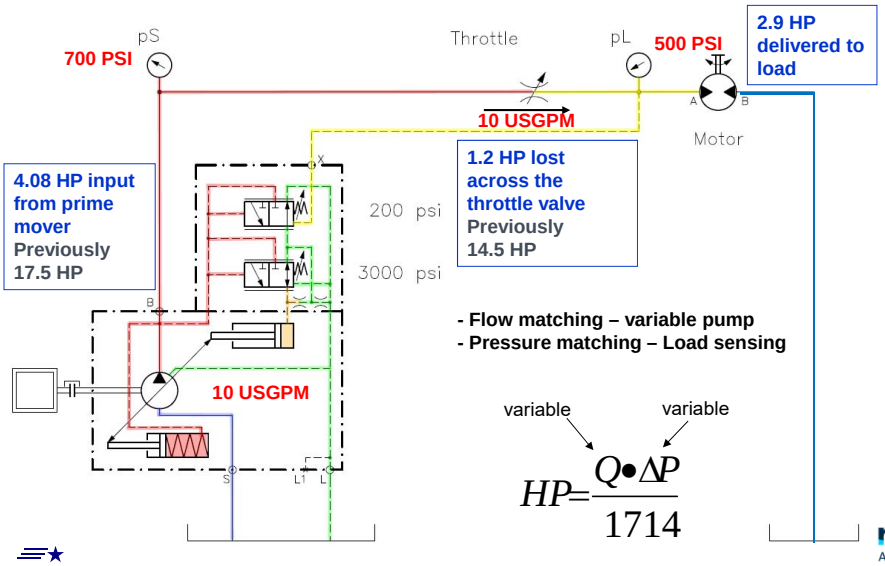
Load Sensing Pumps: power distribution



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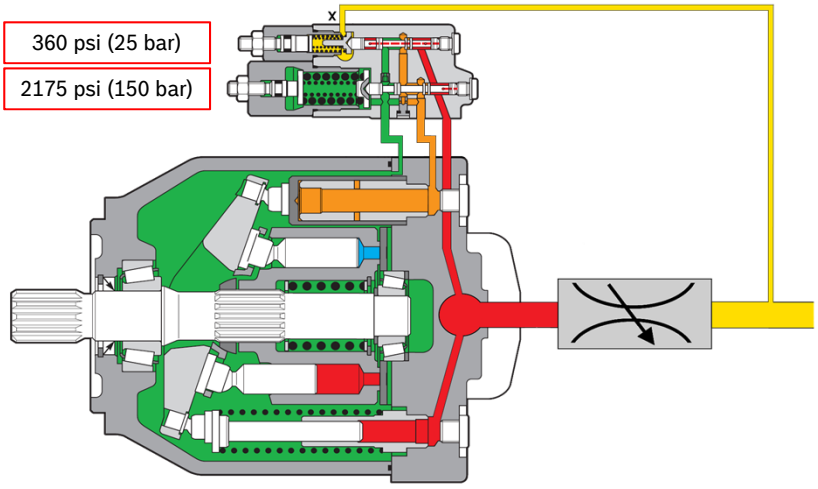
C-S: A10VO DFR1 load sensing pump

360 psi (25 bar)

2175 psi (150 bar)



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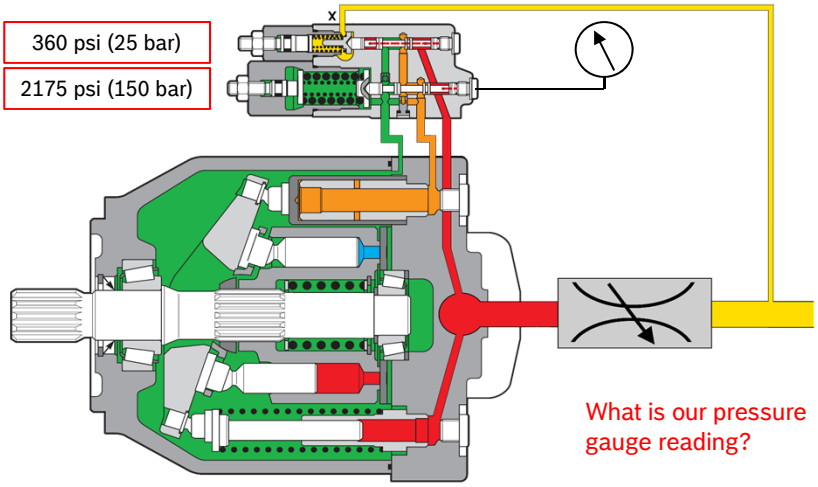

What is our pressure gauge reading?

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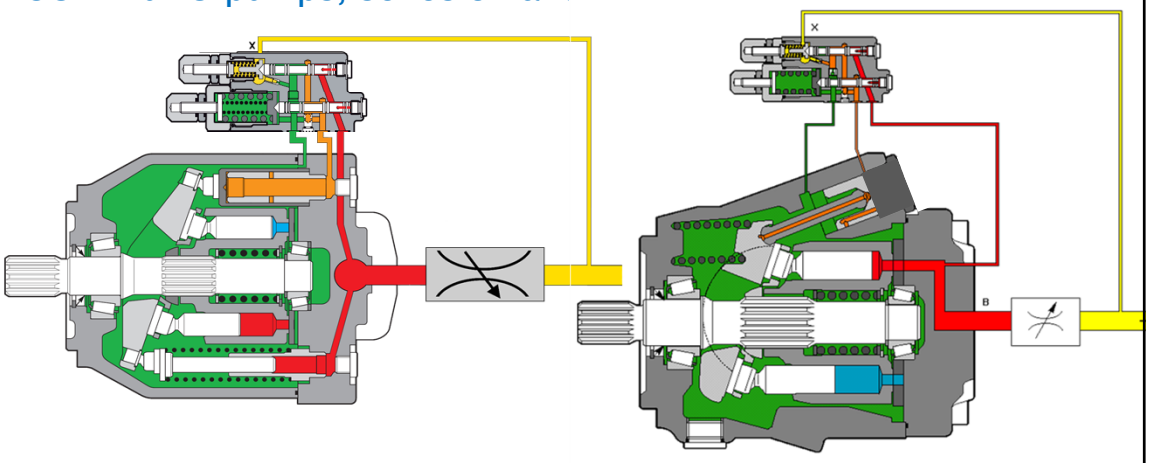
CS: A10VO pumps; series 31 and series 52



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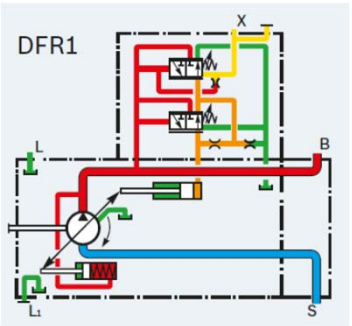
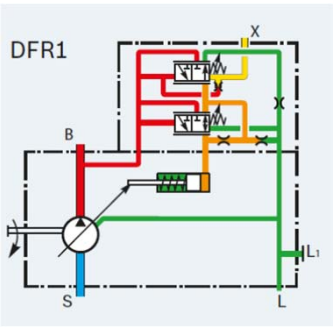
CS: A10VO pumps; series 31 and series 52



Series 31 has a stroking piston and a counter piston



Series 52 has only a stroking piston hence the reason for the orifice

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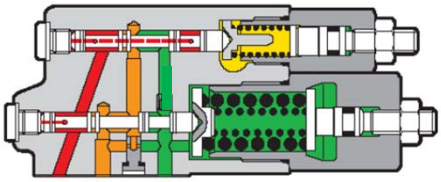
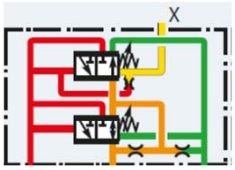
C-S: Load Sensing Controllers, DFR1

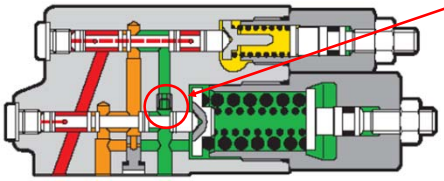
The **only** difference between the two is that the series 52 has an 2.2 mmØ orifice in the tank passage of the controller to control the swivel time of the swash plate.

series 31

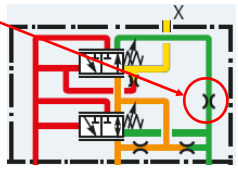




series 52



2.2 mm orifice



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C-S: Load Sensing Controllers, DFR

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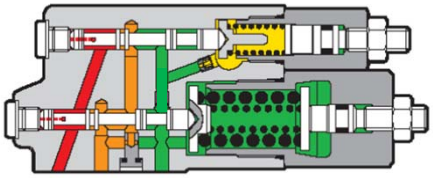
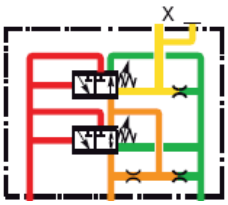
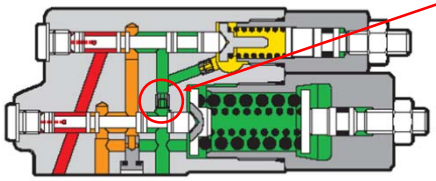
series 31





series 52



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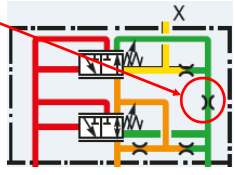

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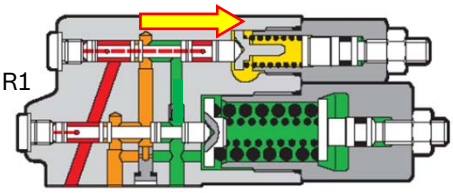
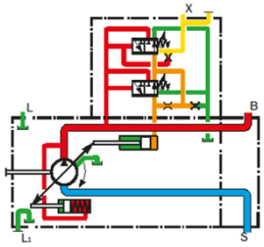
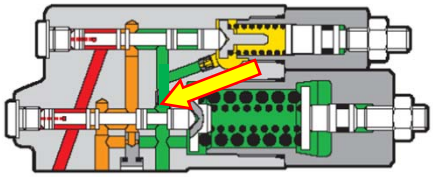
C-S: LS Controllers, understanding the difference for troubleshooting

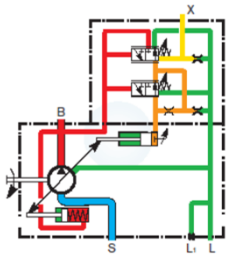
series 31 DFR1





series 31 DFR





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C-S: Load Sensing Controllers, DFR and DFR1 matrix

Controller	Series 31	Series 52
DFR1-S3955 (BA10VDRS-S3955)	**N/A**	**R902518190**
DFR-S3955 (BA10VDRF-S3955)	**N/A**	**R902517027**
DFR1-S4260 (BA10VDRS-S4260)	**R902534795**	**N/A**
DFR-S4260 (BA10VDRF-S4260)	**R902554969**	**N/A**

Explanation of SO Numbers:

S4260 = S3972 + SO413 (for series 31 pumps); S3955 = S3972 + SO413 + S0231 (for series 52 pumps)

S3972 means steel cap nuts on the DR and FR adjustments for corrosion protection in this harsh environment.

SO413 means re-enforced margin spring on FR axis (range from 20-40 bar setting). We now use just one spring (instead of two light springs) with a higher force which means the spool travel is not limited as much is if we used the standard spring package and turned the adjustment in to an higher setting.

SO231 means that there is an 2.2 mm diameter orifice in the 'T'-port passage of the Controller between the FR and DR spools. This is because the series 52 only has one stroking piston to vary the angle of the swash plate.

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Axial Piston Pump type A10VO

- **Overview of pump operation and technical data**
  - Maximum outlet pressure

Output operating pressure range
Pressure at port B
Nominal pressure p_N ——— 4000 psi (280 bar)
Peak pressure p_{max} ——— 5100 psi (350 bar)
(Pressure data to DIN 24312)
Intermittend operating pressures up to 4600 psi (315 bar) are possible at 10 % duty cycle.

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Axial Piston Pump type A10VO

- **Overview of pump operation and technical data**
  - Maximum outlet pressure
  - Inlet pressure range

Input operating pressure range
Absolute pressure at port S (A)
$p_{abs\ min}$ ——— 12 psi (0.8 bar)
$p_{abs\ max}$ ——— 435 psi (30 bar)

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Axial Piston Pump type A10VO

- **Overview of pump operation and technical data**
  - Maximum outlet pressure
  - Inlet pressure range
  - Maximum case pressure + Inlet/Case differential

Case drain pressure

maximum pressure of leakage fluid (at ports L, L1):

a maximum of 7 psi (0.5 bar) higher than the inlet pressure at port S, however, not higher than 30 psia (2 bar absolute)

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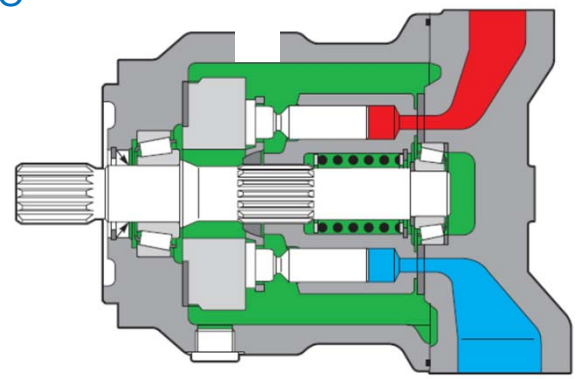
Axial Piston Pump type A10VO



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Axial Piston Pump type A10VO

- **Overview of pump operation and technical data**
  - Maximum outlet pressure
  - Inlet pressure range
  - Maximum case pressure + Inlet/Case differential
  - Viscosity requirements *(operating viscosity)*

Operating viscosity range
In order to obtain optimum efficiency and service life, we recommend that the operating viscosity (at operating temperature) be selected from within the range

Optimum viscosity ($\nu_{opt.}$) __80...170 SUS (16...36 mm²/s)

referred to tank temperature (open loop circuit).

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Axial Piston Pump type A10VO

- **Overview of pump operation and technical data**
  - Maximum outlet pressure
  - Inlet pressure range
  - Maximum case pressure + Inlet/Case differential
  - Viscosity requirements *(viscosity limitations)*

Limits of viscosity range
The following values are valid for extreme operating conditions:

ν_{min} = 60 SUS (10 mm²/s)
for short periods at max. leakage oil temperature of 195°F (90°C)

ν_{max} = 4600 SUS (1000 mm²/s)
for short periods upon cold start.

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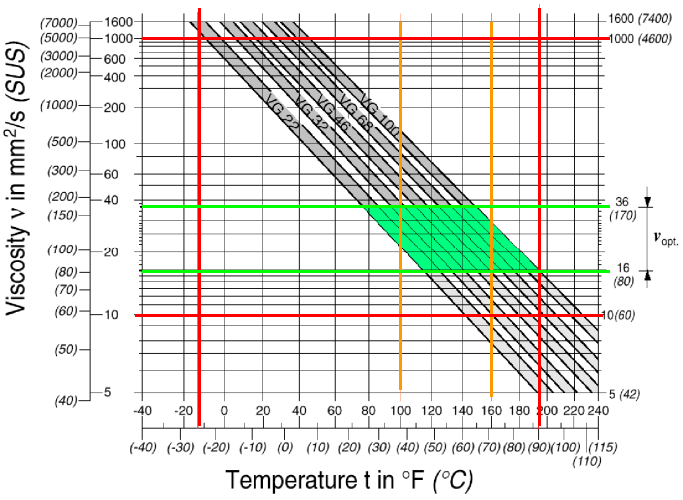
Viscosity requirements



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Axial Piston Pump type A10VO

- **Overview of pump operation and technical data**
  - Maximum outlet pressure
  - Inlet pressure range
  - Maximum case pressure + Inlet/Case differential
  - Viscosity requirements
  - Cleanliness requirements

Filtration of fluid
In order to ensure correct functioning of the unit, a minimum level of cleanliness
to NAS 1638 class 9,
to SAE class 6 or
to ISO/DIS 4406 class 18/15 is required.
This may be achieved, for example, with filter elements type ...D 020... (see RA 31278).
Hence the following degree of separation is produced

$\beta_{20} \geq 100$.

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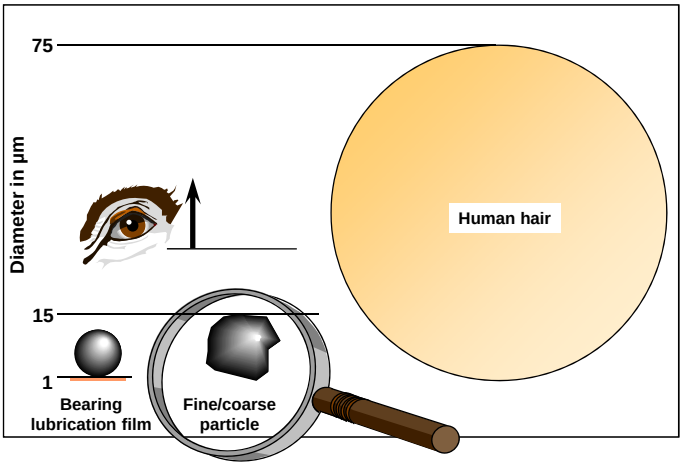
Contamination – Particle Proportions



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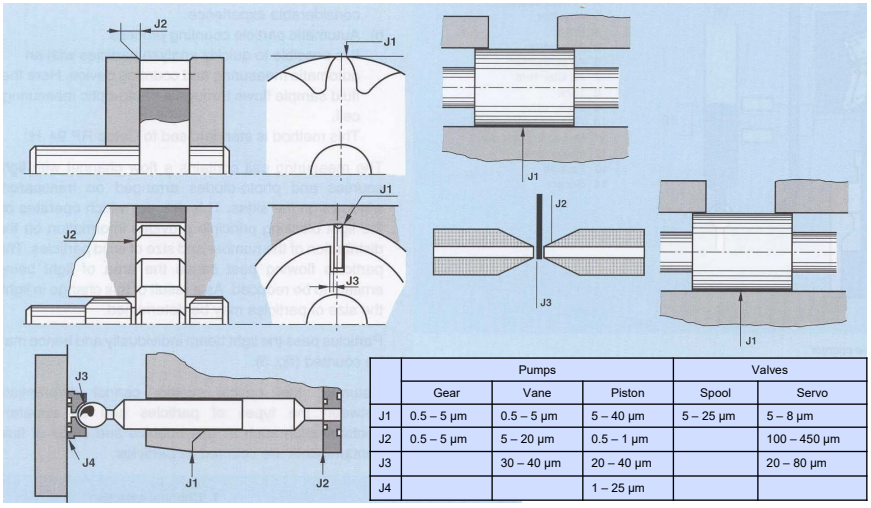
Critical Tolerances in Hydraulic Components



	Pumps			Valves	
	Gear	Vane	Piston	Spool	Servo
J1	0.5 – 5 µm	0.5 – 5 µm	5 – 40 µm	5 – 25 µm	5 – 8 µm
J2	0.5 – 5 µm	5 – 20 µm	0.5 – 1 µm		100 – 450 µm
J3		30 – 40 µm	20 – 40 µm		20 – 80 µm
J4			1 – 25 µm		

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C-S: HA10V0140DFR1/31L-PKC62N00 – SO413 R902506871

High Speed version, Left hand rotation (CCW) only; maximum rpm is 2050
140 cc/rev (8.54 cu.in./rev) 4000 psi (250 bar)

mounting flange	spigot	Inlet port	Outlet port	Leakage ports	Keyed shaft	Overall length *	Q USGPM @ 1200 rpm	Q USGPM @ 1800 rpm
SAE-C 2-bolt	5”	2-1/2” code 61	1-1/4” code 62	#12 SAE (1-1/16-12 UNF)	1-3/4” 7/16” key	13.5” (343 mm)	44 (166 l/min)	66 (249 l/min)

* from mounting flange face to end of port plate.

Q @ 700 rpm = 25 USGPM

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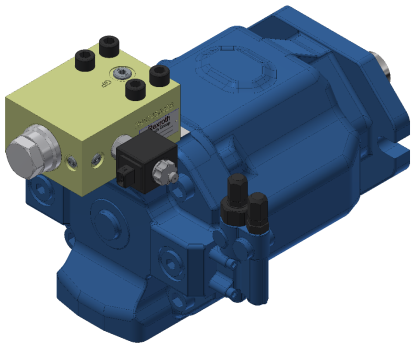
Compu-Spread: Low Oil Shut Off Valves (LOSOV)

“LOSOV” (loss of) hydraulic fluid in your system due to a broken hose?

With a Bosch Rexroth shut-off valve, you can protect the heart of the circuit by ensuring the variable displacement pump won’t run dry



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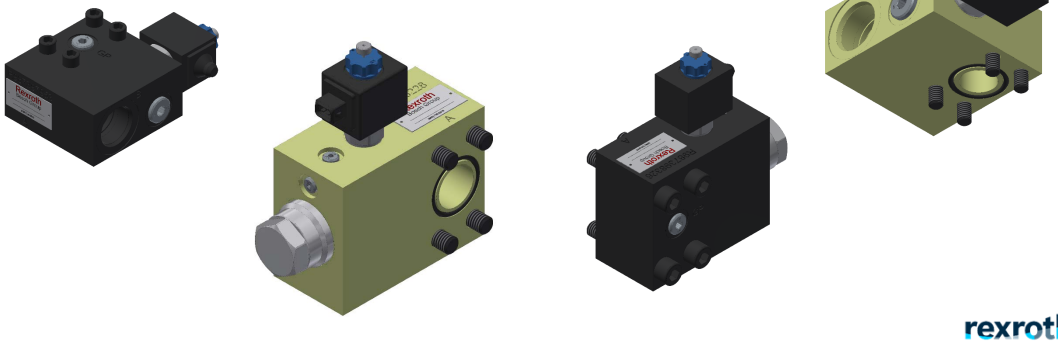
Compu-Spread: Low Oil Shut Off Valves (LOSOV)

- In both ductile iron as well as aluminium housings
- Solenoids with either C4 connectors or with flying leads
- In-line or flange mounted (code 61 or code 62, depending on the pump's outlet port)
- Direct acting or pilot operated (depending on the flow rate)



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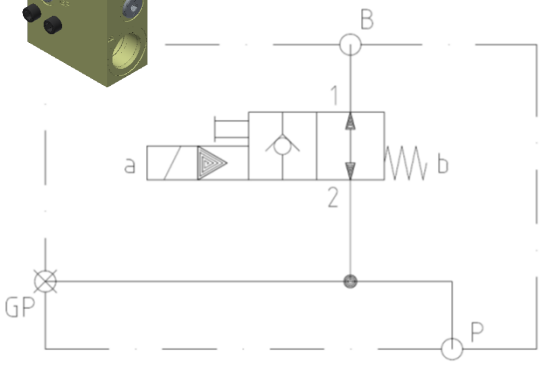
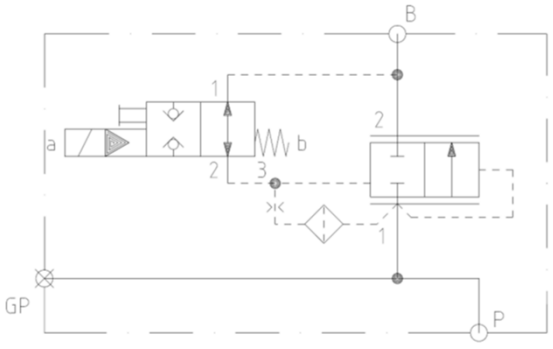
Compu-Spread: Low Oil Shut Off Valves (LOSOV)





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Compu-Spread: Low Oil Shut Off Valves (LOSOV)

material #	description	Inlet port	Outlet port	El. Connector	housing mat'l
R987397657	CS-LOSOV-1X/210-10061-16UNF/G12NFL	1" SAE flange code 61	#16 SAE (1-5/16-12 UNF)	flying leads	aluminium
R987479238	CS-LOSOV-1X/210-10061-16UNF/G12NC4	1" SAE flange code 61	#16 SAE (1-5/16-12 UNF)	C4	aluminium
R987398323	CS-LOSOV-1X/345-10061-16UNF/G12NFL	1" SAE flange code 61	#16 SAE (1-5/16-12 UNF)	flying leads	ductile iron
R987483459	CS-LOSOV-1X/345-10061-16UNF/G12NC4	1" SAE flange code 61	#16 SAE (1-5/16-12 UNF)	C4	ductile iron
R987398325	CS-LOSOV-1X/210-12562-20UNF/G12NFL	1-1/4" SAE flange code 62	#20 SAE (1-5/8-12 UNF)	flying leads	aluminium
R987466761	CS-LOSOV-1X/210-12562-20UNF/G12NC4	1-1/4" SAE flange code 62	#20 SAE (1-5/8-12 UNF)	C4	aluminium
R987463072	CS-LOSOV-1X/345-12562-20UNF/G12NC4	1-1/4" SAE flange code 62	#20 SAE (1-5/8-12 UNF)	C4	ductile iron

* anything above 3000 psi system pressure requires the ductile iron version to be used

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Internal Technical Bulletin

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Compu-Spread A10V(N)O Pump Quick Dimensions Guide

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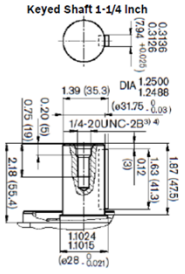
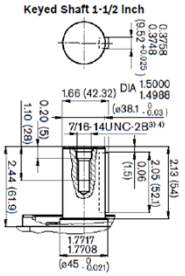
pump type	mounting flange	spigot	inlet port	outlet port	leakage ports	keyed shaft	keyway	splined shaft	thread in shaft
series 31									
A10VO28	SAE-B 2-bolt	4"	1-1/4" code 61	3/4" code 61	SAE-08	7/8"	1/4"		1/4-20UNC x 3/4"
A10VO45	SAE-B 2-bolt	4"	1-1/2" code 61	1" code 61	SAE-10	1"	1/4"		
A10VO71/74	SAE-C 2-bolt	5"	2" code 61	1" code 61	SAE-10	1-1/4"	5/16"		5/16-18UNC x 3/4"
A10VO71/74	SAE-C 2-bolt	5"	2" code 61	1" code 61	SAE-10			1-1/4" 14T 12/24 DP	5/16-18UNC x 3/4"
A10VO100	SAE-C 2-bolt	5"	2-1/2" code 61	1-1/4" code 62	SAE-12	1-1/2"	3/8"		7/16-14UNC x 1-1/8"
series 52									
A10VO45	SAE-B 2-bolt	4"	SAE-24	SAE-16	SAE-10	1"	1/4"		1/4-20UNC x 5/8"
A10VO60	SAE-B 2-bolt	4"	2" code 61	1" code 61	SAE-10	1-1/4"	5/16"		1/4-20UNC x 5/8"
A10VO60	SAE-B 2-bolt	4"	2" code 61	1" code 61	SAE-10			1" 15T 16/32 DP	1/4-20UNC x 5/8"
A10VO85	SAE-C 2-bolt	5"	2-1/2" code 61	1-1/4" code 62	SAE-12	1-1/2"	3/8"		7/16-14UNC x 1-1/8"
series 53									
A10VNO85	SAE-B 2-bolt	4"	2" code 61	1" code 61	SAE-10			1-1/4" 14T 12/24 DP	5/16-18UNC x 3/4"

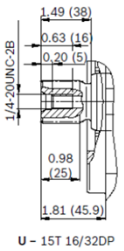
Keyed Shaft 1-1/4 inch



Keyed Shaft 1-1/2 inch

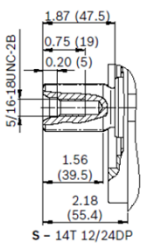


Splined shaft 1 in SAE J744



U – 15T 16/32DP

Splined shaft 1 1/4 in SAE J744



S – 14T 12/24DP

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