Z E N D A R

OPERATION AND MAINTENANCE MANUAL

DARTRON INDUSTRIES, INC.

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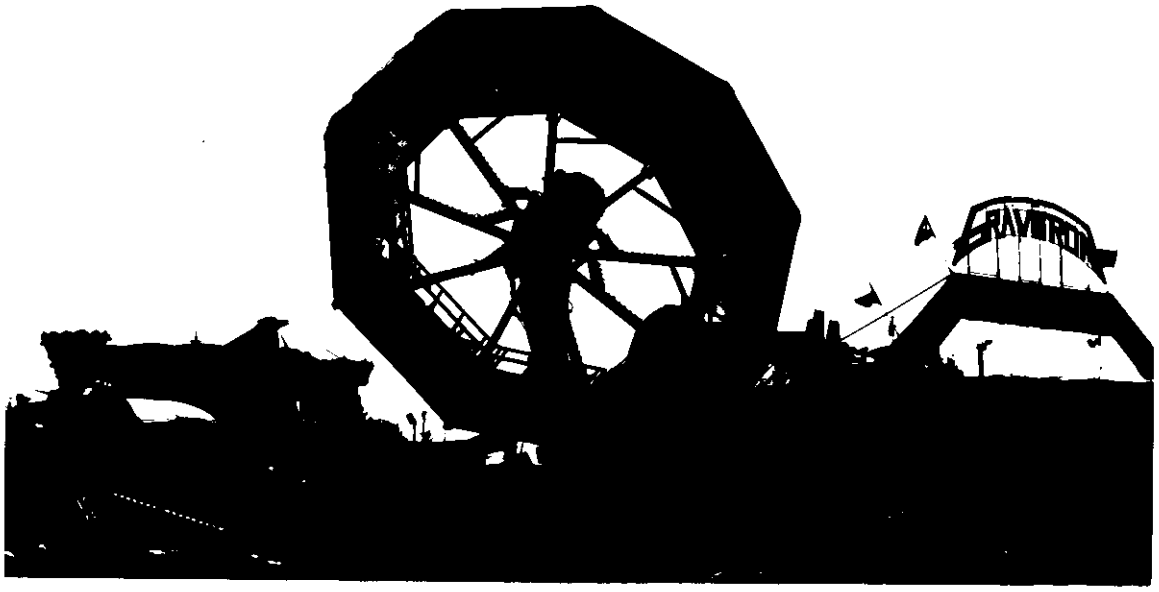
GRAVITRON


GRAVITRON

INTRODUCTION

This manual is intended to be used as a general guide for the operation and maintenance of your ride. Dartron Industries, Inc. is constantly striving to improve performance, efficiency and safety; therefore, certain improvements may not be reflected in the text of the manual. Any major revisions or additions to the manual will be sent to you free of charge. Specially engineered features purchased for individual rides may not be incorporated in this manual.

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SPECIFICATIONS

TOTAL POWER REQUIRED	85 kw
POWERED BY	50 hp, 1750 rpm electric motor
MAXIMUM AMP DRAW	225 amps
VOLTAGE	220 volt, 3 phase <u>with ground</u>
ELECTRICAL LEAD WIRES	Standard: Five individual wires with type W insulation. Power wires are 02 size & ground is 00. Optional: Single cable that contains power leads & ground. Type W insulation.
LIGHTING	Mini Turbo lights 60v 4w bulbs Turbo lights 110v 10w bulbs Console spotlights 12v 35w bulbs Outer skin spotlights 24v 35w bulbs Panel lights 110v 11w bulbs Floodlights 110v 500w quartz halogen bulbs Rotating beacon 110v rotational motor 12v 30w bulbs
CAPACITY	34 adults or children with combined weight of 5800 lbs.
MAXIMUM OPERATING HEIGHT	37 feet
SPACE REQUIRED	55 feet by 40 feet
TRAILER LENGTH	28 feet
RIDE SPEED	19.5 rpm
PASSENGER MINIMUM HEIGHT REQUIREMENT	48 inches

♠ <u>CAUTION</u>: Failure to supply an adequate ground to the frame can cause serious electric shock. Proper grounding prevents the metal parts of the Zendar from being energized with high voltage in the event of a short circuit. Another means of grounding is with a ground rod. Check local regulations for ground rod requirements and specifications.

SYSTEM OVERRIDE AND EMERGENCY PROCEDURES

I. Electrical or hydraulic power is interrupted while boom is in up position.

A. Wheel is not tilted.

When electrical or hydraulic power is interrupted, holding valves located on the boom lift cylinders will close trapping hydraulic fluid in the lift cylinders and maintaining the boom at that location. To lower boom without hydraulic or electrical power locate the lift cylinder valve override handle located inboard of cooling fan on the rear of the hydraulic fluid storage reservoir. The override handle is about 5" long with a rounded end. Rotate the handle 90 degrees. This action will allow hydraulic fluid to slowly exit the lift cylinders and allow the boom to gently return to the boom rest pad. CAUTION: After lowering boom return override handle to closed position. With override handle in open position boom cannot be raised.

B. Wheel is tilted.

When electrical or hydraulic power is interrupted, holding valves on the boom lift cylinders will be bypassed hydraulically, allowing fluid from the base of the lift cylinders to fill the rod end of the drag link cylinder. This in turn brings the wheel automatically level.

To lower boom locate the lift cylinder valve override handle inboard of the cooling fan. Rotate the handle 90 degrees. This will allow fluid to exit the lift cylinders and will slowly lower boom.

CAUTION: RETURN OVERRIDE HANDLE TO CLOSED POSITION. BOOM CANNOT BE RAISED WITH HANDLE IN OPEN POSITION.

II. Ride occupant creates a situation requiring the ride motion to be stopped or occupant be removed immediately

Return to the operator's console. Switch to manual mode. Level the wheel with the tilt control. Once wheel is level, turn rotation switch off. When wheel is no longer rotating, lower boom with joystick.

III. Ride operator sees an electrical problem and needs to stop the ride and interrupt electrical power to hydraulic system.

Push down mushroom head button labeled EMERGENCY STOP. Breaker for hydraulic system is tripped allowing wheel to rotate in a freewheel mode

until it stops. As the wheel slows to below 18 rpm, the wheel will automatically level. To operate ride after using emergency stop button the EMERGENCY STOP button must be pulled up then the breaker must be reset to its original position.

IV. After stopping wheel ride operator chooses to unload ride.

If electrical power has not been interrupted lower boom by moving joy stick toward bottom of operators console. If electrical power has been interrupted lower boom by opening lift cylinder valve override handle located inboard of the cooling fan.

V. If power is interrupted from loss of power at source or by pushing EMERGENCY STOP mushroom switch, the wheel will immediately free wheel for several seconds.

CAUTION: AFTER OPENING LIFT CYLINDER OVERRIDE VALVE, BOOM WILL NOT STAY IN THE AIR UNTIL VALVE HAS BEEN CLOSED.

VI. Hydraulic lines to link arm cylinder are ruptured.

This type of failure will prevent wheel from being returned to the level position with the emergency re-level system explained in I.B. above or with the joy stick. The operator must push the emergency STOP mushroom switch to place the wheel in free wheel and hold the boom down joy stick in the DOWN position.

VII. Operator observes hydraulic fluid gushing from a broken hydraulic line or fitting.

A. Push the emergency STOP mushroom switch; then place Wheel Tilt/Level joystick in the LEVEL position.

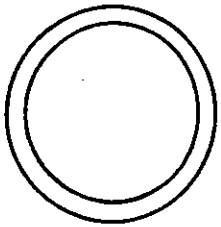
B. If the wheel does not respond to the Tilt/Level joystick, move rapidly to the boom override handle and lower the boom. As the boom lowers, cables between the spindle base and the boom will tighten. These safety cables will prevent the sweeps from hitting the boom and will cause the link cylinder to collapse and allow the wheel to return to a level position.

VIII. If wheel RPM's drop below 17 RPM, the wheel will automatically go into the free wheel mode and return to the level position.

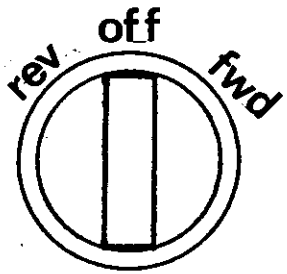
IX. If all the above procedures fail and the wheel stops or slows below 17 RPM while in the Tilt mode, passengers will be held safely in their cages by the safety belts fastened across the front of the cell.

The operator should push the emergency STOP mushroom switch and go quickly to boom override valve and lower the boom. Safety cables will level the wheel allowing passengers to be safely removed.

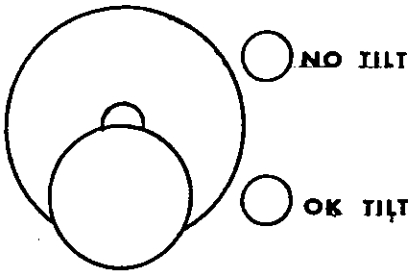
start



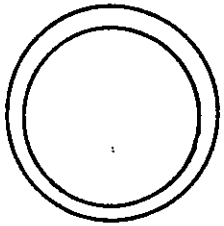
ROTATION



TILT



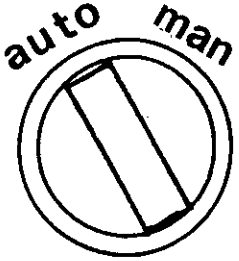
EMERGENCY



HYDRAULIC

LEVEL

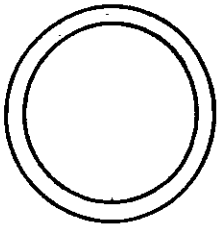
PUSH TO STOP



SYSTEM

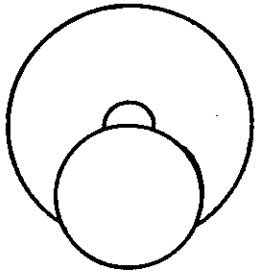
Zendar

stop



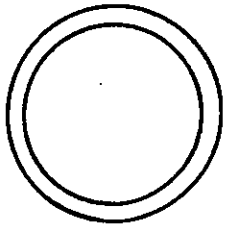
BOOM

up



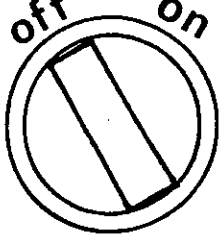
down

JOG



OPERATE WITH BRAKE ON AND ROTATE SELECTED

BRAKE



OPERATING INSTRUCTIONS

I. MANUAL OPERATION OF RIDE

PLACE MODE SELECTION SWITCH IN MAN (manual) POSITION.

1. To start motor and hydraulic system push button labeled HYDRAULIC SYSTEM ON. Allow system to warm up until the temperature of the hydraulic system reaches 50 degrees. Hydraulic fluid will warm up before temperature gauge indicates 50 degrees because the gauge is exposed to the open air. Hydraulic pump will quiet down when fluid is warm enough.

2. Place switch labeled ROTATION in the FWD (forward) position. Rotation will not occur at this time. (When rotation does begin, the FWD position will cause the wheel to rotate in a counter clockwise direction.)

3. Move BOOM LIFT joystick to the UP position. Boom will rise until it reaches its maximum height and then will stop by itself. Release joy stick after upward movement of the boom stops.

4. Wheel rotation will start at this time. When tilt speed is achieved, the red diode labeled NO TILT will go out, and the green diode labeled OK TILT will illuminate.

5. Operator must observe all passengers and verify that all are in cages with safety belts fastened. Operator must not tilt the wheel until observing that all passengers are in cages with safety belts fastened.

6. When the OK TILT diode illuminates, move the TILT joystick to the TILT position. This action will cause the wheel to tilt. When the tilt position is achieved, the tilt action will stop by itself. NOTE: The wheel will not tilt until adequate wheel speed is achieved.

7. NOTE: The boom cannot be lowered unless the wheel is level. To level the wheel, move the TILT joystick to the LEVEL position. The wheel tilt movement will stop by itself when the wheel is level.

8. To lower the boom move the BOOM joystick to the DOWN position. As soon as downward movement starts, the wheel will cease rotating. Use

the BRAKE ON switch to stop the wheel rotation so that the exit and entry doors are above the exit and entry platforms.

9. When the boom reaches the boom rest, downward movement will stop by itself. Release the joy stick.

10. If the doors do not line up with the loading platforms, select the direction of rotation needed by placing the ROTATION switch in either the FORWARD or REVERSE position. Depress the JOG button. The wheel will rotate while the button is depressed. Releasing the JOG button will set the brake and stop wheel rotation.

II. AUTOMATIC OPERATION OF RIDE

PLACE MODE SELECTION SWITCH IN AUTO POSITION

1. To start motor and hydraulic system push button labeled HYDRAULIC SYSTEM ON. Allow system to warm up until the temperature of the hydraulic system reaches 50 degrees. Hydraulic fluid will warm up before temperature gauge indicates 50 degrees because the gauge is exposed to the open air. Hydraulic pump will quiet down when fluid is warm enough.

2. Place switch labeled ROTATION in the OFF position.

3. Move BOOM joystick to the UP position. Boom will rise until it reaches its maximum height and then will stop by itself. Release joy stick after upward movement of the boom stops.

4. Wheel rotation will start at this time. When tilt speed is achieved, the red diode labeled NO TILT will go out, and the green diode labeled OK TILT will illuminate.

5. Operator must observe all passengers and verify that all are in cages with safety belts fastened. Operator must not tilt the wheel until observing that all passengers are in cages with safety belts fastened.

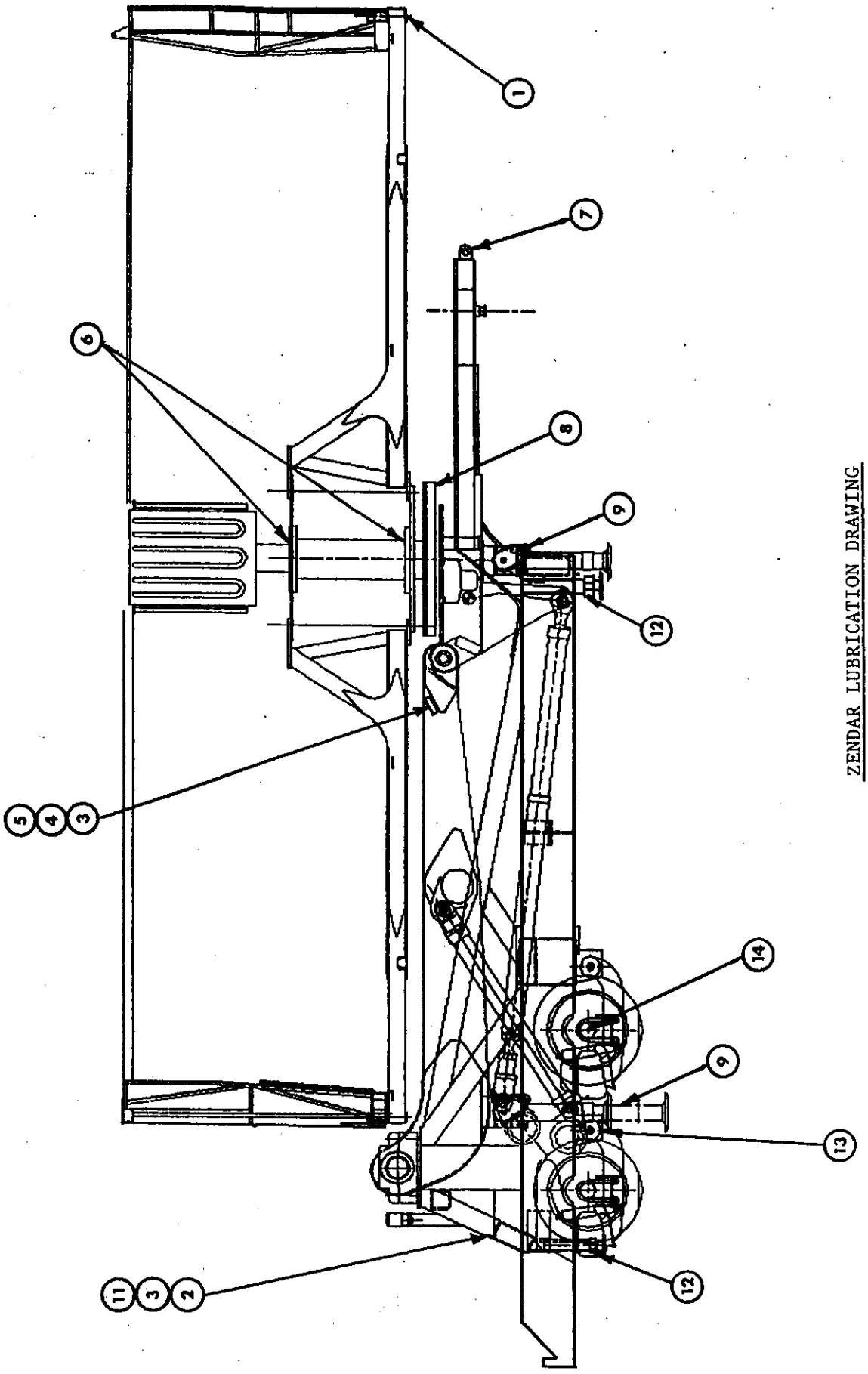
6. When the OK TILT diode illuminates, move the TILT joystick to the TILT position. This action will cause the wheel to tilt. When the tilt position is achieved, the tilt action will stop by itself. NOTE: The wheel will not tilt until adequate wheel speed is achieved.

7. After a pre-set number of seconds, the wheel will automatically return to the level position and stop rotating.

8. To lower the boom move the BOOM joystick to the DOWN position. Use the BRAKE ON switch to stop the wheel rotation so that the exit and entry doors are above the exit and entry platforms.

9. When the boom reaches the boom rest, downward movement will stop by itself. Release the joy stick.

10. If the doors do not line up with the loading platforms, select the direction of rotation needed by placing the ROTATION switch in either the FORWARD or REVERSE position. Depress the JOG button. The wheel will rotate while the button is depressed. Releasing the JOG button will set the brake and stop wheel rotation.



ZENDAR LUBRICATION DRAWING

RECOMMENDED LUBRICANTS

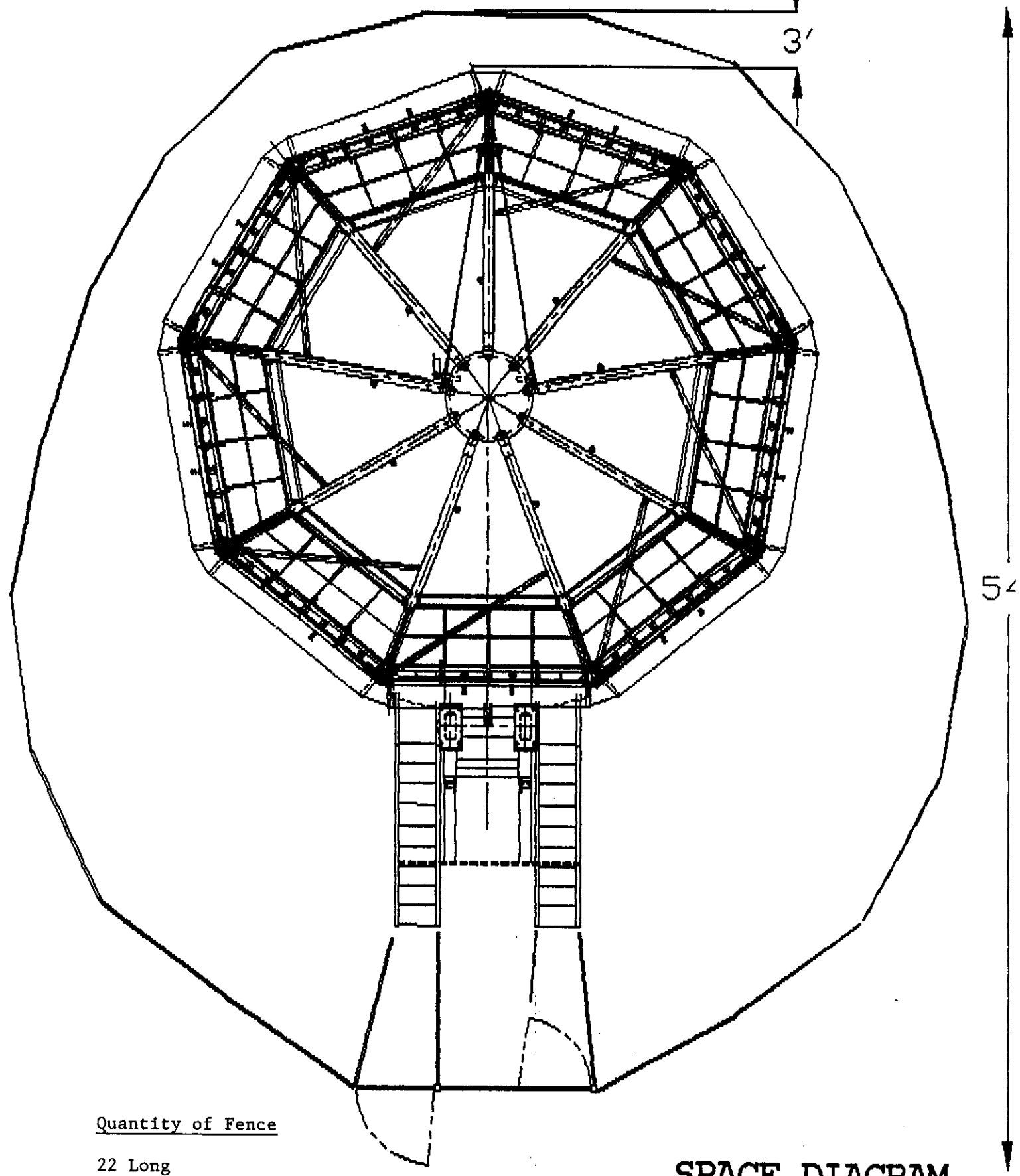
BRAND	GREASE	PINION GREASE	HYDRAULIC OIL	GEAR OIL
Chevron	Ultra Duty EP 2	Open Gear Lubricant	150 46	RPM Universal 80W90
Texaco	Starplex 2	Texclad 2	Rando Oil HD 46	Multigear 80W90
Mobil	SCH 460	N/A	DTE 15M	Mobil Lube HD 80W90
Pennzoil	Pennlith Ultra	N/A	Pennzbell AW 46	#4092 80W90
B.P.	N/A	N/A	HLP HD 46	Transgear 80W90
Valvoline	N/A	N/A	043	#838 80W90
Amsoil (Synthetic)	Multi-Purpose GLC	N/A	AHO 15046	AGR 80W90

N/A = Not Available

LUBRICATION MAINTENANCE SCHEDULE

FIG.#	ITEM	TYPE OF LUBRICANT	FREQUENCY
1	Cage assembly pivot pin	Grease	Monthly
2	Boom pillow block bearings	Grease	Daily*
3	Link arm ends	Grease	Daily *
4	Upper cylinder pin	Grease	Daily *
5	Boom platform pivot pin	Grease	Daily *
6	Upper & lower center hub bearings	Grease	Weekly
7	Front storage boom bearings	Grease	Monthly
8	Main drive gear	Pinion Grease	Monthly
9	Landing gear (3 each)	Grease	Monthly
10	Outrigger screw jack	Grease	Monthly
11	Lower cylinder pin	Grease	Daily *
12	Front & rear screw jacks	Grease	Monthly
13	Rear brake activators (8)	Grease	Monthly
14	Axles	Gear Oil	Check Daily
15	Hydraulic Tank	Hydraulic Fluid	Check Daily

* On Manifold Block



Quantity of Fence

22 Long
2 Short
2 Gates

SPACE DIAGRAM

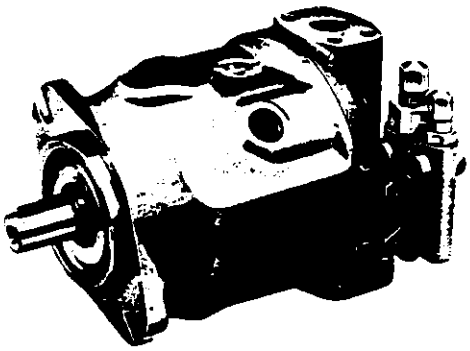
REXROTH
WORLDWIDE HYDRAULICS

Variable Axial Piston Pump, Swashplate Design Model AA10VSO (Series 30) for Open Circuit Applications

Sizes 28 to 100	...4570 PSI (...315 bar)	...6.10 in³/rev (...100 cm³/rev)

RA 06 291/06.87

- 2-bolt mounting flange to SAE standards
- SAE flanged connections with UNC threads (SAE J 518)
- Special slot-controlled swashplate design
- High power to weight ratio
- Heavy duty roller bearings for extremely long pump life
- Various control options for pressure, flow and power regulation
- Fast response times and low noise level
- Continuous operating pressure of 3625 PSI (250 bar), peak pressure to 4570 PSI (315 bar)
- Axial and radial loading of the drive shaft possible
- Good self-priming suction characteristics
- Cast iron housing, aluminium free construction
- Operation on water based fluids 95/5 (HFA emulsions) possible with de-rated performance parameters

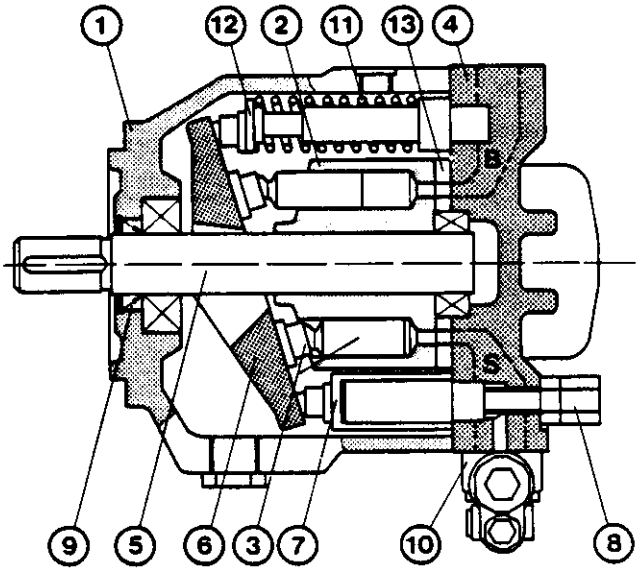


Functional Description

Axial piston pumps model AA10VSO are swashplate design, variable displacement pumps. They are designed for hydrostatic transmission in open circuit applications. The pump generates fluid flow and imparts to that fluid the necessary pressure forces up to 4570 PSI (250 bar).
They basically consist of the housing (1), cylinder barrel (2), piston and shoes (3), port plate (4), drive shaft (5), swash plate (6), control piston (7), mechanical stroke limiter adjustment (8), shaft seal (9) and compensator control (10).
Rotation of the drive shaft (5) causes a linear piston movement as the piston shoe (3) slides along the tilted swashplate (6).
As the piston retracts in the cylinder bore (2), fluid fills the developing vacuum cavity from the suction port »S« via the suction kidney in valve plate (13). At maximum retraction of the piston, shaft rotation causes the piston to go beyond the suction kidney and begin communication with the pressure kidney. Continuing rotation then extends the piston into the cylinder bore, forcing fluid into the pressure port »B«.
The stroke length of the piston is directly related to the swashplate angle, which swivels up to a maximum of 17 degrees for stepless flow adjustment.

Pressure and flow regulation

The swashplate is normally held at maximum swivel angle by a spring (11) as well as system pressure working on the stroking piston (12).
System pressure is also working on the pressure compensator against a setting spring. When system pressure overcomes the spring force, the spool shifts allowing system pressure into the control piston (7). This causes the pump to destroke to a regulating point sufficient to maintain compensator set pressure and lubricating fluid flow.
When the pressure setting is reached, only the amount of fluid necessary to satisfy the load conditions is delivered. If the load condition is such that no flow is required, only cooling and lubricating fluid is delivered. Power usage and heating of the fluid are thus kept to a minimum.
When system pressure falls below the compensator setting, spring force returns the spool back to its normal position, which drains control piston (7) to the pump case. The swashplate is then forced on stroke by the spring (11) and stroking piston (12). The flow control spool FR, also known as load sensing control, functions generally the same as the compensator spool. In the case of the FR spool, however, its response is due to a differential pressure across a flow control device. The spring setting only determines the differential pressure required to maintain constant output flow through a given orifice size.
Many control options including constant power control, electronic proportional flow and/or pressure control, etc. are available.



Variable Axial Piston Pump AA10VSO, Series 30

Ordering Code

	A	A10VS	O			/	30		–		K	C	62	

Hydraulic Fluid

Petroleum oils no designation	
HFA- HFB- and HFC-fluids	E-

Version

SAE *	A

Axial Piston Unit

Variable displacement, swashplate design for industrial use	A10VS

Function

Pump operation, open circuit	O

Size

Sizes		28	45	71	100
Displacement	in^3/rev	1.71	2.75	4.33	6.10
	(cm^3/rev)	28.0	45.0	71.0	100.0

Controls and Control Options

Pressure compensator				DR
Pressure/flow compensator**				DFR
Constant power control***				DFLR
Electrical flow control	FE			FE
	FE	D		FED
with pressure compensation				

** A bleed orifice to drain is installed in X-port standard; if plug is to be installed state in clear text.

*** When ordering please state power requirements in clear text ex. 1 1/2 HP at 1800 rpm (5 kW at 1500 rpm)

Design

Series	30

Direction of Rotation

looking at shaft end	clockwise	R
	counter-clockwise	L

Seals

Buna-N	P
Viton	V

Shaft End

Keyed parallel, SAE	K

Mounting Flange

SAE 2-bolt	C

Port Connections

Pressure port B: SAE Suction port S: SAE	on opposite sides, with UNC threads	62

Through-drive Configurations

			28	45	71	100	
Without through-drive			●	●	●	●	N00
mounting flange	shaft/coupling	to fit:					
SAE A, 2-bolt	SAE A, spline	G2[1], S15[1], S20[1], AA 10 V 16	●	●	●		K01
SAE B, 2-bolt	SAE B, spline	G3[1], S20[1], S30[1], AA10 VO 28		●	●		K02
SAE B, 2-bolt	SAE B, keyed	AA 10 VSO 28, S30[1]	●	●	●		K03
SAE B-B, 2-bolt	SAE B-B, keyed	AA 10 VSO 45		●	●		K05
SAE C, 2-bolt	SAE C, keyed	AA 10 VSO 71, V2/50...100			●		K06

Please note: The mechanical stroke limitation from full displacement to 50 % full displacement is only available at model »N00« without through drive

[1]See the following data sheets, for further informations on the combination pumps: ● = available
G2- RA 10 030, G3- RA 10 038, S15- RA 64 756, S20- RA 64 774, S30- RA 64 789, V2/50...100- RA 10 337

Hydraulic Fluid

Before project design, please see our data sheet RA 90220 or RA 90223 for detailed information on the selection of hydraulic fluids and their application limits.

Operating viscosity range:

For optimum efficiency and pump life, we recommend that the operating viscosity (at operating temperature) be selected in the range of

ν_{opt} = optimum operating viscosity
81...167 SUS (16...36 mm²/s)

taking into consideration the reservoir temperature range.

Viscosity limits:

The following values are valid for extreme operating conditions of short duration.

ν_{min} = 60 SUS (10 mm²/s)
for short periods at max. permissible drainage oil temperature of 194° F (90° C)

ν_{max} = 4635 SUS (1000 mm²/s)
for short periods upon cold start up

Example:
VG 22 =
Viscosity grade of 22 centistokes
at 104° F (40° C)

Notes on the selection of the hydraulic fluid:

For correct selection of the hydraulic fluid, it is assumed that the operating temperature in the reservoir (open circuits) in relation to the ambient temperature is known.

The hydraulic fluid should be selected so that, within the operating temperature range, the operating viscosity lies within the optimum range ν_{opt} (see shaded area of selection diagram). We recommend that the higher viscosity grade is selected in each case.

Example: At some ambient temperature of X°, the operating temperature in the reservoir is 140° F (60° C). In the optimum operating viscosity range (ν_{opt}, shaded section), this corresponds to viscosity grades VG 46 or VG 68; VG 68 should be selected.

Important: The drainage fluid temperature is influenced by pressure and speed and is always higher than the reservoir temperature. At no point in the system, however, must the temperature be higher than 194° F (90° C).

If it is not possible to comply with the above conditions because of extreme operating parameters or high ambient temperature, please consult us.

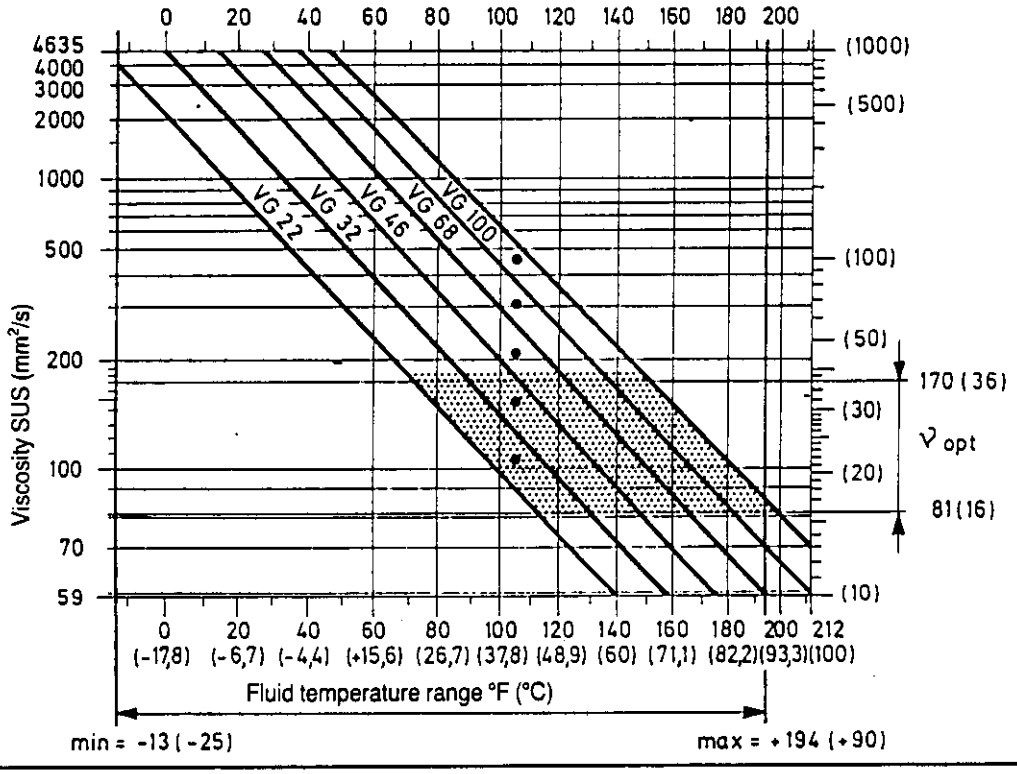
Filtration

In order to guarantee proper and reliable function, the operating fluid must be maintained to a minimum cleanliness grade of 9 to NAS 1638, 6 to SAE, ASTM, AIA or ISO grade 16/15.

This can be achieved, e.g., with filter elements type ... D 020 ... (see RA 31278).

A beta value of $\beta_{20} \geq 100$ is thereby achieved.

Selection Diagram



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Technical Data

Values are valid for petroleum oils for water-content and synthetic fluids please see data sheet RA 90223 for detailed fluid information

Operating pressure range – Inlet Side

Absolute pressure at port S (suction inlet)

$p_{abs\ min}$ ——— 12 PSIA (0.8 bar)
$p_{abs\ max}$ ——— 435 PSIA (30 bar)

Operating pressure range – Outlet Side

Pressure at port B

Nominal pressure p_N ——— 3625 PSI (250 bar)
Peak pressure p_{max} ——— 4570 PSI (315 bar)

Drainage fluid:

Maximum permissible pressure of the case drain (port L): 7 PSI (0.5 bar) maximum higher than inlet pressure at port »S«, but not higher than 30 PSI (2 bar) absolute.

Direction of flow:

Port »S« to port »B«

Speed in relation to inlet pressure and displacement:

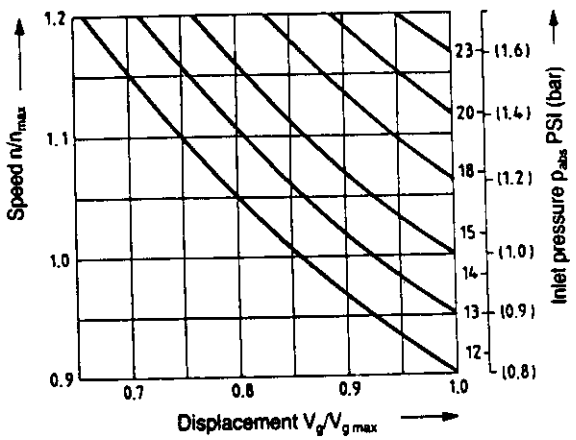


Table of Values

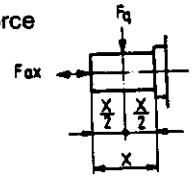
Theoretical values, without considering mechanical η_{mh} and volumetric η_v efficiencies

Size				28	45	71	100
Displacement: $V_{g\ max}$			in³/rev (cm³)	1.71 (28)	2.75 (45)	4.33 (71)	6.10 (100)
Nominal flow*: at n_E = 1750 rpm			GPM (l/min)	12.7 (48)	20.1 (76)	32.0 (121)	45.0 (170)
at $n_{o\ max}$			GPM (l/min)	21.4 (81)	29.9 (113)	40.2 (152)	51.3 (194)
Maximum speed**: (flooded suction)		$n_{o\ max}$	rpm	3000	2600	2200	2000
Max. power:	– n_E = 1750 rpm		HP (kW)	27.5 (20.5)	44.3 (33.0)	69.9 (51.9)	98.2 (73.1)
Δp = 3625 PSI (250 bar)	– $n_{o\ max}$	$P_{o\ max}$	HP (kW)	47.0 (35.0)	65.8 (49.0)	87.2 (65.0)	111.4 (83.0)
Max. torque:	Δp = 3625 PSI (250 bar)		lb-ft (Nm)	81.9 (111)	132 (179)	208 (282)	293 (397)
Torque	Δp = 1450 PSI (100 bar)		lb-ft (Nm)	33 (45)	53 (72)	83 (113)	117 (159)
Moment of inertia about the drive axis		J	lb-ft² (kgm²)	0.0403 (0.0017)	0.0783 (0.0033)	0.1968 (0.0083)	0.3960 (0.0167)
Filling volume:			Pints (l)	1.48 (0.7)	2.11 (1.0)	3.38 (1.6)	4.64 (2.2)
Weight: (approx)			lbs (kg)	33.0 (15)	46.2 (21)	72.6 (33)	99 (45)
Permissible loading on drive shaft: (see below) max. axial force F_{ax}			lbs (N)	225 (1000)	337 (1500)	540 (2400)	900 (4000)
max. radial force F_q			lbs (N)	540 (2400)	810 (3600)	1350 (6000)	2250 (10000)
Mounting Position:				See page 5			
Fluid temperature range:				See diagram, page 3			
Viscosity range:			SUS (mm²/S)	60-4640 (10...1000) Optimum 81-167 (16...36)			

* 3% loss of volume included

** The values shown are measured with an absolute pressure of 14.5 PSI (1 bar) at the suction inlet «S»

Direction of applied force



Sizing Calculations

Flow $Q = \frac{V_g \cdot n \cdot \eta_v}{231}$ $(Q = \frac{V_g \cdot n \cdot \eta_v}{1000})$

Drive torque $M = \frac{V_g \cdot \Delta p}{24 \cdot \pi \cdot \eta_{mh}}$ $(M = \frac{1.59 \cdot V_g \cdot \Delta p}{100 \cdot \eta_{mh}})$

Drive power $P = \frac{M \cdot n}{5252} = \frac{Q \cdot \Delta p}{1714 \cdot \eta_t}$

$(\frac{2\pi \cdot M \cdot n}{60000} = \frac{M \cdot n}{9549} = \frac{Q \cdot \Delta p}{600 \cdot \eta_t})$

V_g = geom. displacement in³/rev (cm³/rev)
Δp = pressure differential PSI (bar)
M = torque lb-ft (Nm)
Q = flow GPM (l/min)
P = drive power HP (kW)
n = speed rpm
η_v = volumetric efficiency
η_{mh} = mechanical efficiency
η_t = overall efficiency ($\eta_t = \eta_v \cdot \eta_{mh}$)

Mounting position

The unit can be mounted in a number of optional positions. The pump housing must be filled prior to start-up.
In order to achieve optimum noise level values, all connecting lines (suction, pressure and leakage) should be elastically connected to the reservoir.
Check valves in leakage return lines should be avoided. Exceptions are possible, subject to our approval in advance.

1. Vertical installation (shaft pointing upwards)

The following installation parameters should be considered:

1.1 Pump submerged in Reservoir

Prior to installation, the pump should be filled while in a horizontal position.

a) The minimum fluid level must be level with or higher than the pump face flange. Connections »L« + »L_1« should be left open (see illustration ✱1)

b) If the minimum fluid level is lower than the pump face flange, then connection »L_1« and possibly the suction (»S«) port must be piped, as per Illustration ✱ 2. Conditions as per item 1.2.1. Port »L« is plugged.

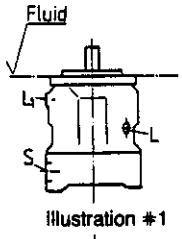


Illustration ✱1

1.2 Pump mounted outside of Reservoir

Prior to installation, the pump should be filled while in a horizontal position. Above-tank mounting as per Illus. ✱ 2.

1.2.1 Operational paramaters. Minimum pump inlet pressure $p_{abs\,min}$=12 PSI (0.8 bar) under static and dynamic loads.
Note: Avoid above-tank mounting whenever a low noise level is desired.

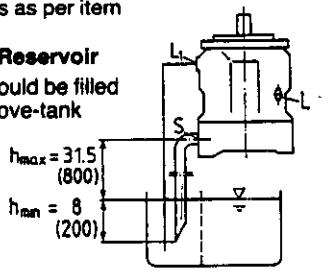


Illustration ✱2

The allowable suction height is a factor of the total pressure loss; it must, however not be greater than h_{max} = 31.5" (800 mm). Submerged depth $h_{T\,min}$ = 8" (200 mm).

Total Pressure loss $\Delta p_{TOTAL} = \Delta p_1 + \Delta p_2 + \Delta p_3 \leq (1 - p_{E\,(min)}) = 2.9$ PSI (0.2 bar)
with Δp_1: Pressure loss in piping due to acceleration of the fluid column.

$$\Delta p_1 = \frac{\varrho \cdot l \cdot dv}{dt} \cdot 10^{-5} \text{ (bar)}$$

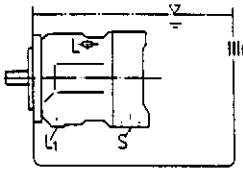
ϱ = thickness of fluid (kg/m³)
l = pipe length (m)
dv/dt = Suction speed differential (m/s²)

Δp_2: Pressure loss through geographic altitude differences

$$\Delta p_2 = h \cdot \varrho \cdot g \cdot 10^{-5} \text{ (bar)}$$

h = altitude (m)
ϱ = thickness of fluid (kg/m³)
g = acceleration of gravity (9.81 m/s²)

Δp_3: line losses (elbows, etc.)
This calculation is valid for controls DR, DFR, DFLR



Illus. ✱3

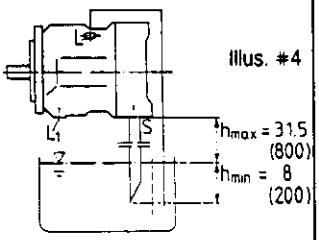
2. Horizontal Installation

Installation should be so that port »L« or »L_1« is at the top of the unit.

2.1 Pump submerged in Reservoir

a) The minimum fluid level on the same level as or higher than the unit's upper surface: Connections »L/L_1« and »S« must be open (see illustration ✱3)

b) The minimum fluid level lower than the unit's upper surface: Connection »L« (or »L_1«) and possibly »S« must be piped, as per Illustration ✱4. Operating parameters as per Item 1.2.1.



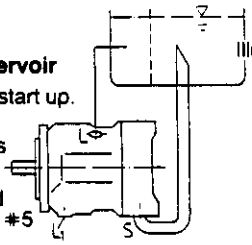
Illus. ✱4

2.2 Pump mounted outside of Reservoir

Pump housing must be filled prior to start up.

a) Above tank mounting as per Illustration ✱4. Operating parameters as per item 1.2.1.

b) Below tank mounting Ports »L« and »S« must be piped as per Illustration ✱5



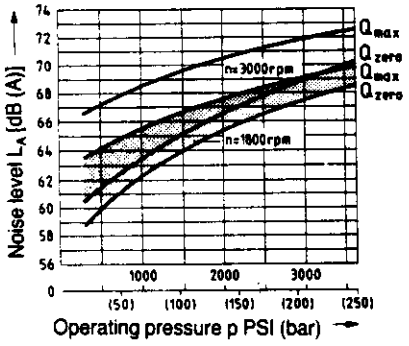
Illus. ✱5

Operating curves with pressure compensator DR

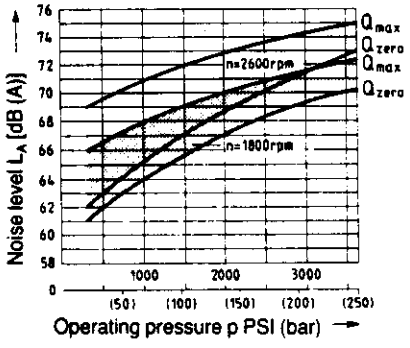
Noise level (standard range)

Measured in an anechoic chamber
Distance from microphone to pump = 3.28 ft (1 m)
Measurement error ±2 dB (A)
Fluid used: petroleum oil per ISO VG 46, DIN-standard ✱51519; temperature: 122° F (50° C)

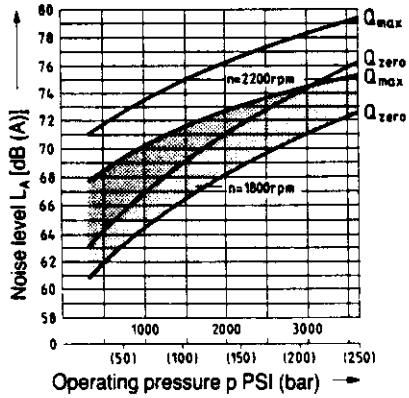
Size 28



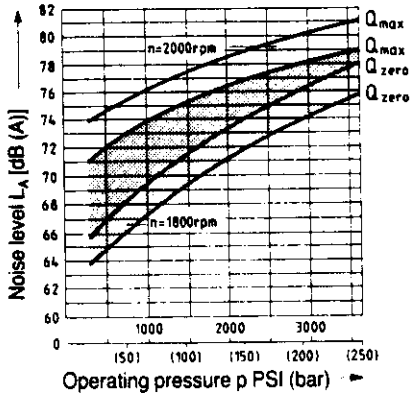
Size 45



Size 71



Size 100

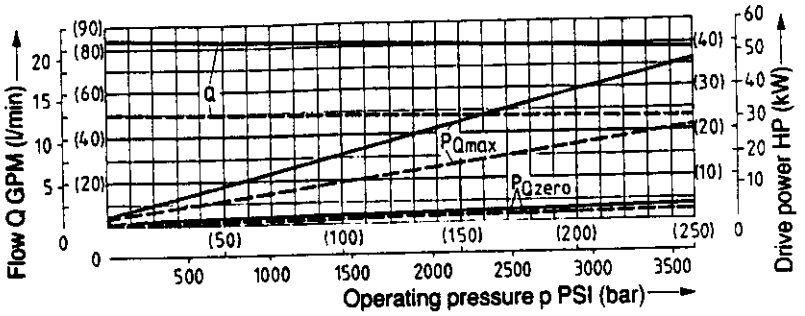


Drive power and output flow

(Fluid: petroleum oil per ISO VG 46, DIN-standard #51519, temperature 122° F (50° C)

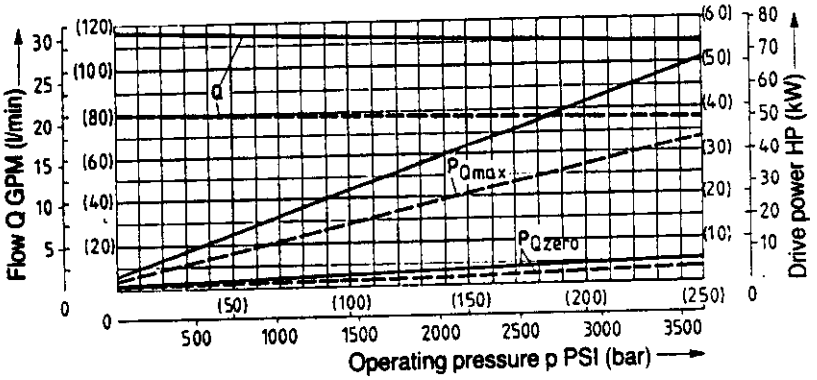
Size 28

_____ n = 1800 rpm
_____ n = 3000 rpm



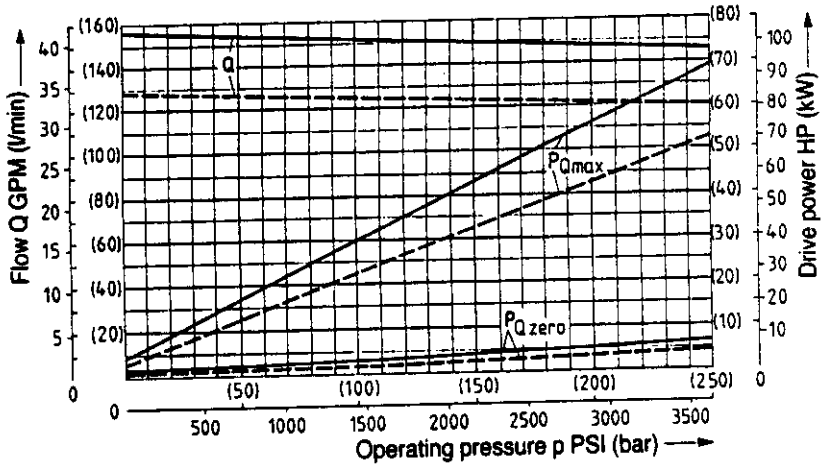
Size 45

_____ n = 1800 rpm
_____ n = 2600 rpm



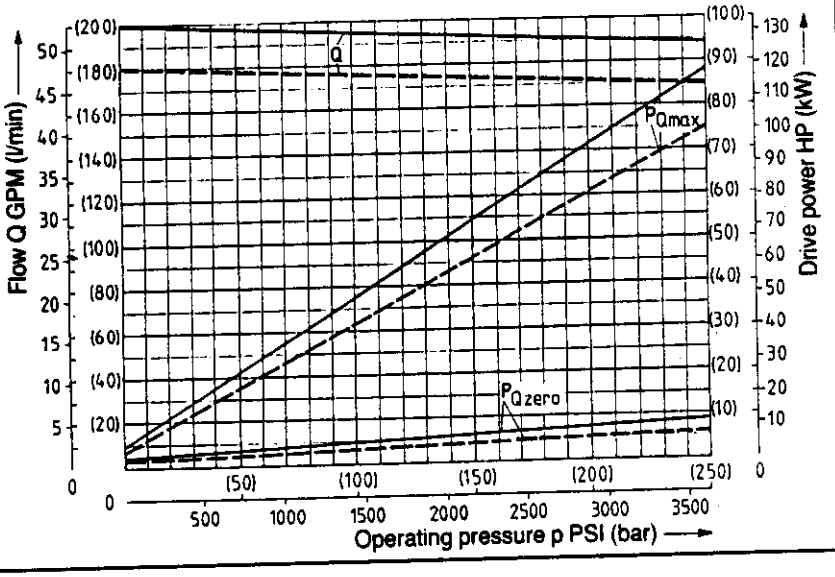
Size 71

_____ n = 1800 rpm
_____ n = 2200 rpm



Size 100

_____ n = 1800 rpm
_____ n = 2000 rpm



Overall efficiency:

$$\eta_t = \frac{Q \cdot p}{p_{Q\,max} \cdot 1714} \left(\frac{Q \cdot p}{p_{Q\,max} \cdot 600} \right)$$

Volumetric efficiency:

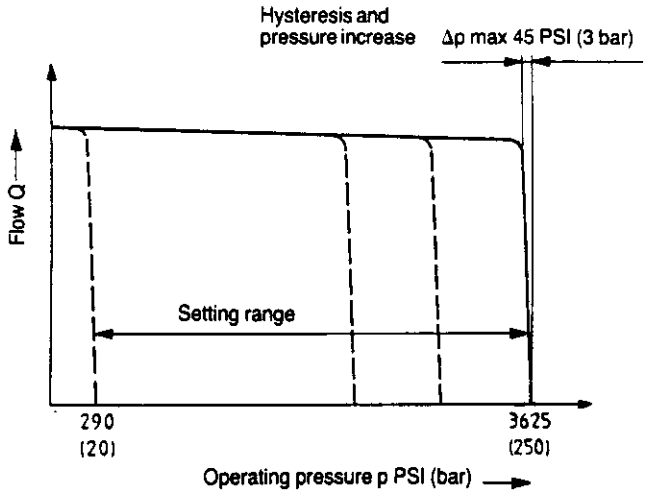
$$\eta_t = \frac{Q}{Q_{theor}}$$

Constant pressure compensator DR

The constant pressure compensator serves to maintain a constant pressure in a hydraulic system, within the control range of the pump. The pump supplies only the amount of hydraulic fluid required. Pressure may be steplessly set at the pilot valve.
Adjustable mechanical flow limiter from $V_{g\,max}$ to 50 % $V_{g\,max}$ only possible on model without through drive (N00).

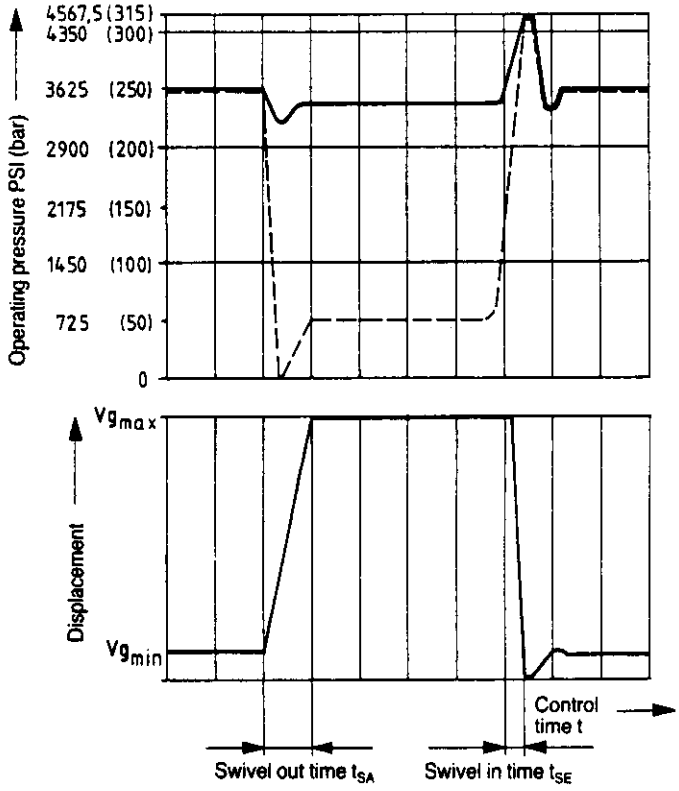
Static operating curve

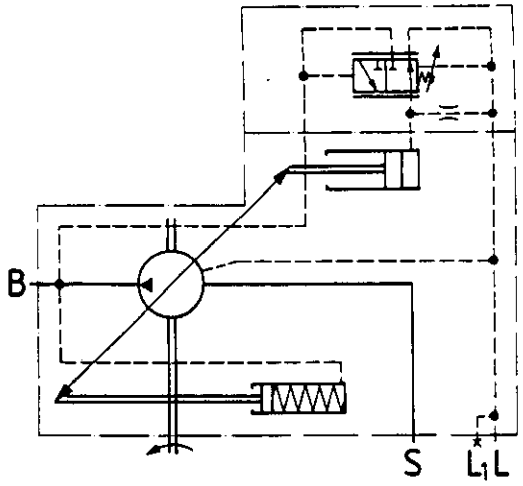
at n_1 = 1500 rpm; t_{oil} = 122° F (50° C)



Dynamic operating curves

Curves are measured average values under testconditions, with unit submerged.
Conditions: n_1 = 1500 rpm;
t_{oil} = 122° F (50° C)
relief set at 4570 PSI (315 bar)
Sudden closing of the pressure line, via relief valve DBD, approx. 3.28 ft (1 m) from the port plate of the pump.





0.80 GPM (3 l/min) pilot flow is required, taken from the high pressure side of the circuit.

Remote pressure control via port X of the flow control valve see page 9.

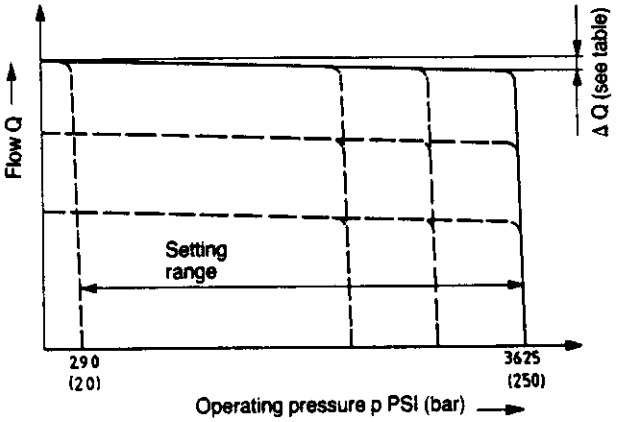
Size	t_{SA} (ms) toward 725 PSI (50 bar)	t_{SA} (ms) toward 3625 PSI (250 bar)	t_{SE} (ms) o-Displacement 3625 PSI (250 bar)
28	60	30	20
45	80	40	20
71	100	50	25
100	200	100	25

Constant pressure/flow compensator DFR

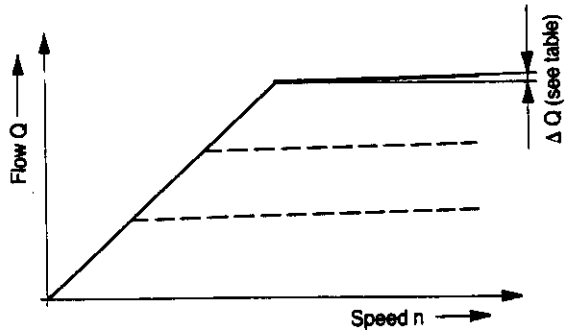
In addition to the constant pressure control, the pump flow may be regulated by means of a differential pressure (e. g. an orifice installed in the service line) »load sensing«. Adjustable mechanical flow limiter from $V_{g\,max}$ to 50 % $V_{g\,max}$ only possible on model without through drive (N00).

Static operating curve

at n_1 = 1500 rpm; t_{oil} = 122° F (50° C)



Static operating curve at variable speed



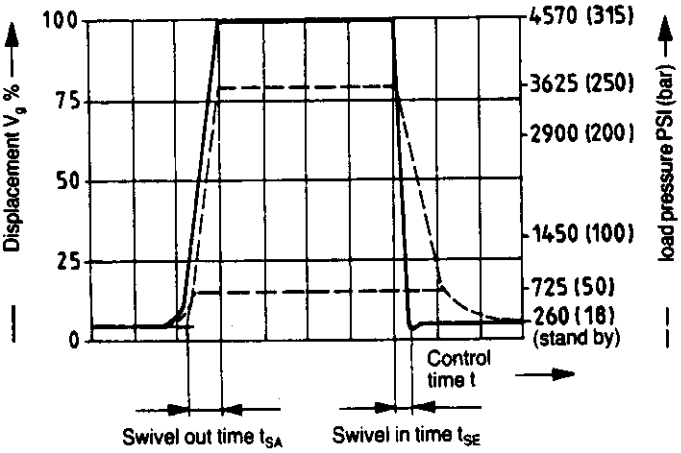
Max. flow variation

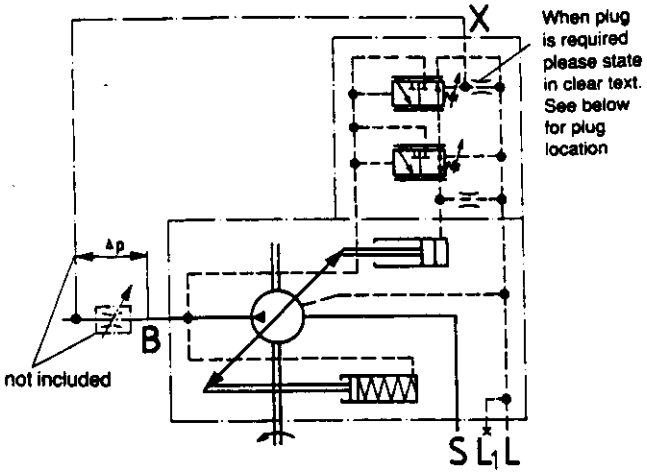
(Hysteresis and increase)
measured at drive speed n = 1500 rpm

Size		28	45	71	100
ΔQ	Gpm (l/min)	0.26 (1)	0.48 (1.8)	0.74 (2.8)	1.06 (4.0)

Dynamic operating curve

Curves are measured average values under test conditions, with unit submerged.





A maximum of 1.32 GPM (5 l/min) is required for pilot flow.

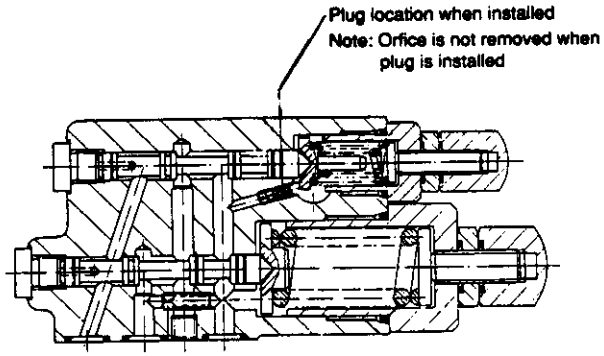
Differential pressure Δp:
settable between 145 and 435 PSI (10 and 30 bar)
standard setting 205 PSI (14 bar)

By unloading port X to tank, a zero stroke (deadhead) pressure of 260 PSI (18 bar) ± 30 PSI (2 bar) is achieved.

Valve options at Port »B«

(not included in pump, to be ordered separately)

Mobile valve block SP 12 (RA 64144)
Mobile valve block SP 18 (RA 64147)
Mobile valve block MP 18 (RA 64594)
Mobile valve block MP 22 (RA 64598)
Proportional valve 4WRE (RA 29060)



Size	t_{SA} (ms) stand by–250 bar 3625 PSI	t_{SE} (ms) 250 bar–stand by 3625 PSI	t_{SE} 50 bar–stand by 725 PSI
28	40	20	40
45	50	25	50
71	60	30	60
100	120	60	120

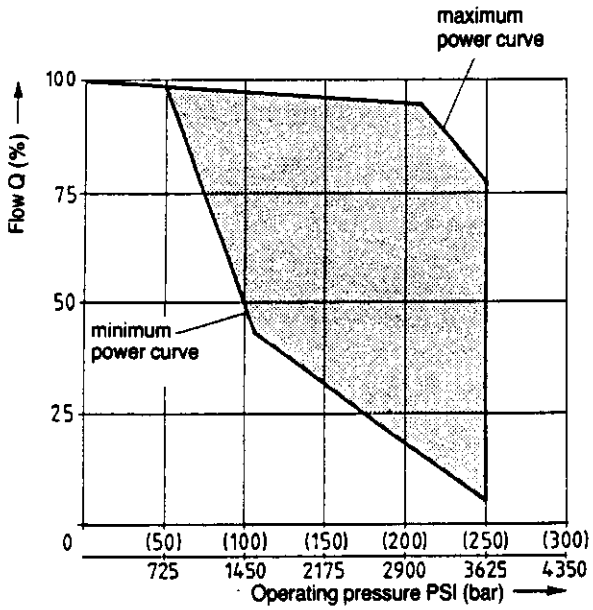
Constant pressure/flow/power control DFLR

In order to achieve a constant drive torque with a varying operating pressure, the swivel angle and with it the output flow of the axial piston pump is varied so that the product of flow and pressure remains constant.

Below the power curve, it is possible to control the output flow.

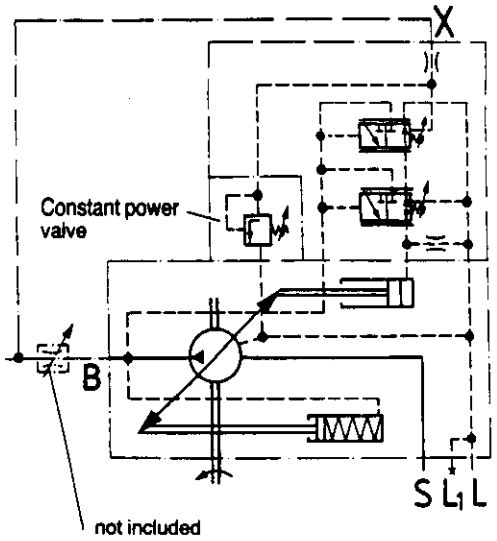
Adjustable mechanical flow limiter from $V_{g\,max}$ to 50 % $V_{g\,max}$ only possible on model without through drive (N00).

Static operating curve



Begin of regulation at 725 PSI (50 bar)

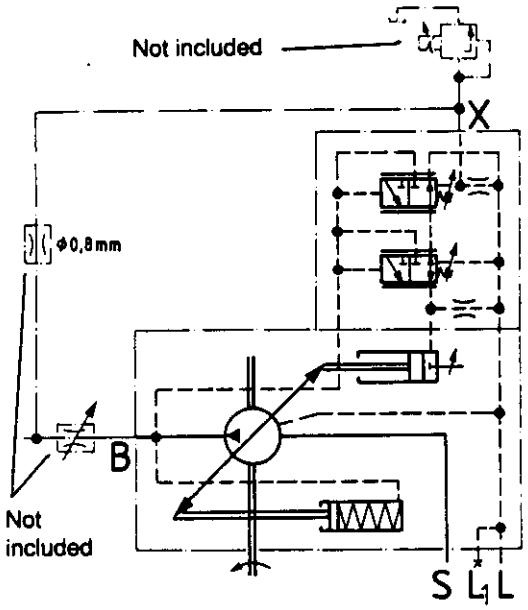
When ordering, please state power setting in clear text, e. g. 7 1/2 HP at 1800 rpm (5 kW at 1500 rpm).



A maximum of 1.45 GPM (5.5 l/min) pilot flow is required.

By unloading port X to tank, a zero stroke (deadhead) pressure of 260 PSI (18 bar) ± 30 PSI (2 bar) is achieved (»stand by«).

Optional remote pressure compensation
(by using the DFR valve)



This option is assembled by customer at time of installation. Therefore the pressure relief valve, throttle valve and orifice ø0.031in (ø0.8mm) are not included with the DFR control. As a pressure relief valve we would recommend:

DBDH-6 hydraulic (RA 25 402);
DBET-30 electrical (RA 29 142);
DBETR electrical (RA 29 166).

Note that remote relief valve is used as a pilot on the "X" port of FR valve. So the FR spool must function even if load sensing is not needed.

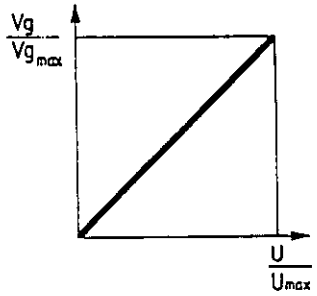
Throttle valve at "B" port is only used to illustrate load sensing or flow control if desired. This throttle is not necessary for proper operation of remote pressure control. The ø0.031in (ø0.8mm) orifice in the sensing line is needed, and must be supplied by the customer.

Max. line length should not exceed 6-1/2 ft (2m).

Electrical flow control FE

The pump displacement is controlled via an electrically operated proportional pilot valve.
The pump position feedback is realized via an inductive positional transducer.
The amplifier card VT 5036 (see page 11 and also RA 29957) regulates the pumpflow. This card is not an integral part of the pump and must be ordered separately.
Adjustable mechanic flow limiter from $V_{g\,max}$ to 50 % $V_{g\,max}$ only possible on model without throughdrive (N00).

Static operating curve

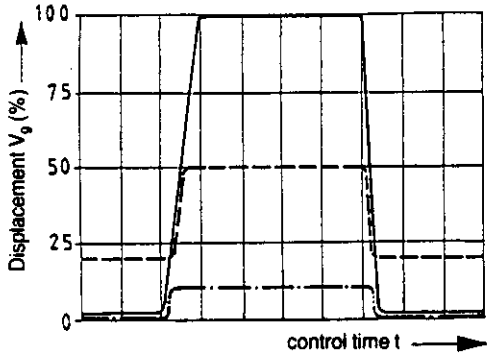


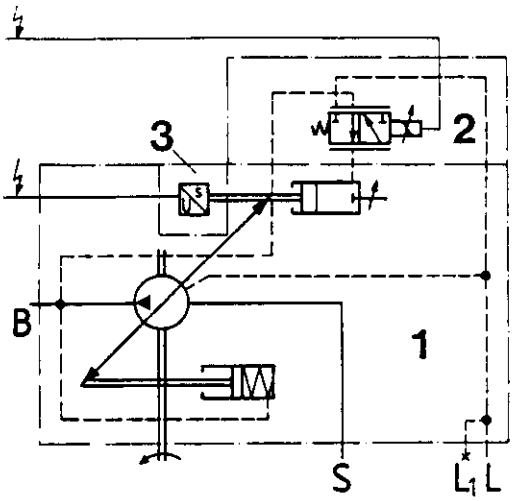
Hysteresis: ≤ ± 1 % of $V_{g\,max}$
Repeatibility: ≤ ± 1 %

Dynamic operating curve

Flow step between two different orifices upon sudden changeover.

Flow/time-curve





Design elements

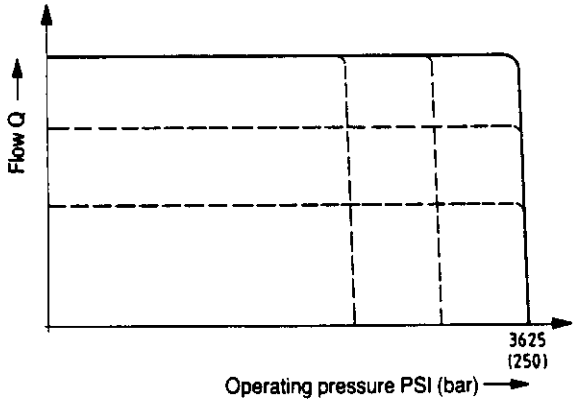
1) AA10VSO with hydraulic control
2) Control valve ENV 202-4-0
3) Inductive positional-transducer (feedback) type IW9-03-01

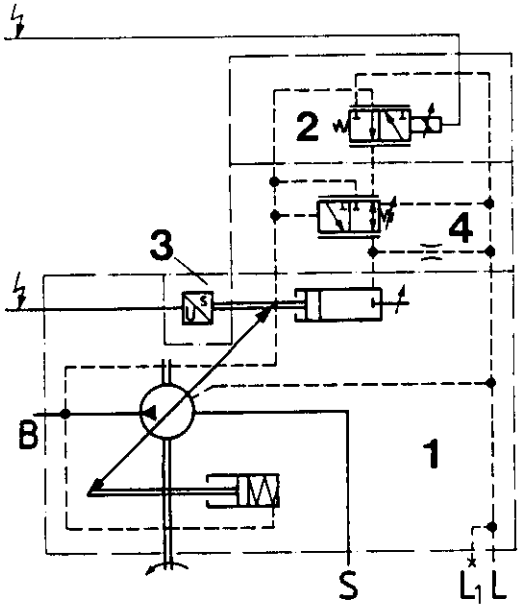
Technical Data

min. required pilot pressure	290 PSI (20 bar)
Control Valve	
current type	DC
supply voltage	24 V
load resistance at 68°F (20°C)	12 Ω
operating time	100%
ambient temperature	...122°F (50°C)
spool temperature	...302°F (150°C)
insulation per DIN 40050	IP 65
isolation class per VDE 0580	F
Inductive positional transducer:	
frequency range	1000 Hz... 5000Hz
inductivity	9.5 mH

Variation: electrical flow control with pressure compensation FED

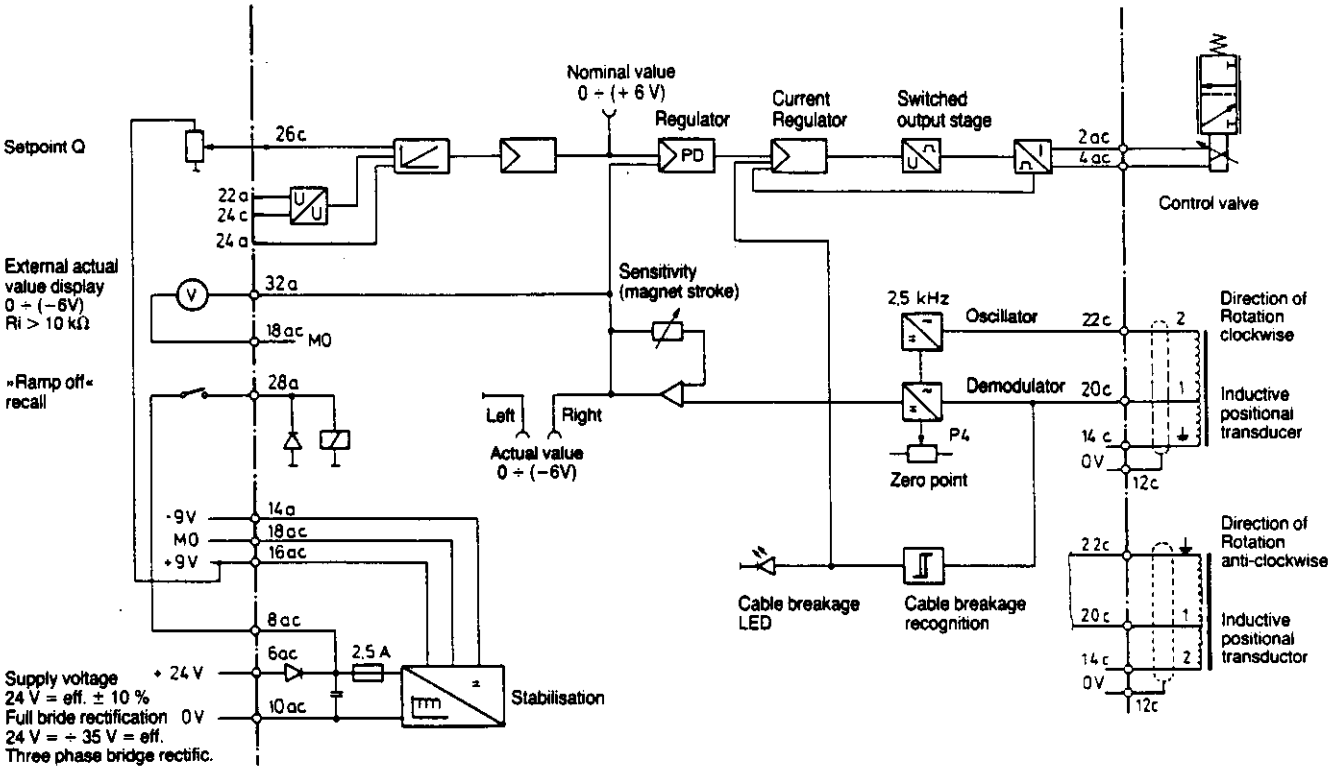
This variation incorporates an additional valve (Pos. 4) into the control, so that a hydraulic pressure compensation function is also available.





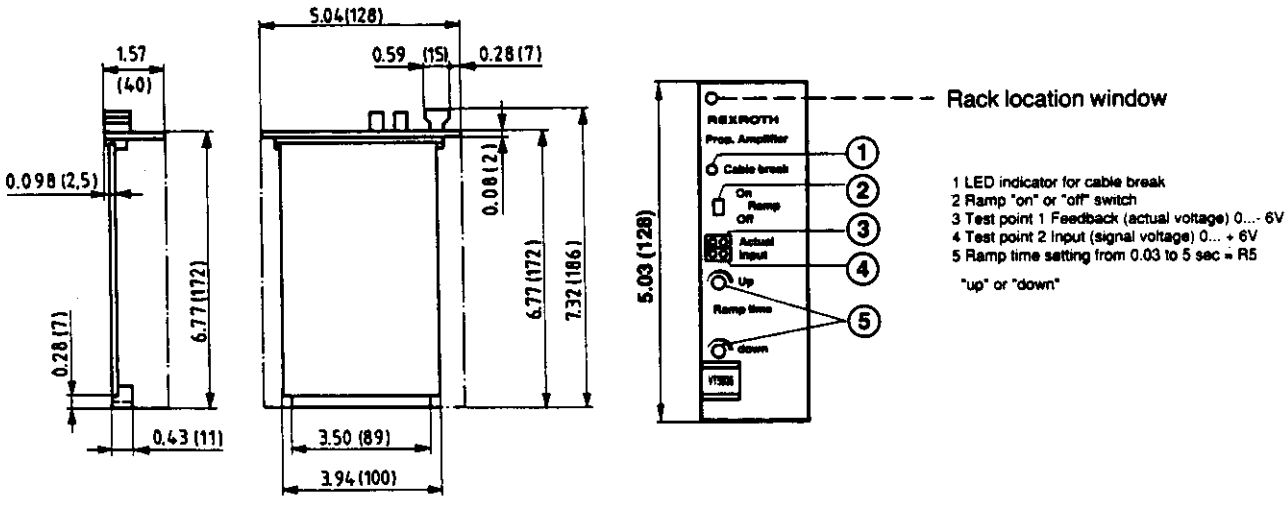
Proportional amplifier card VT 5036

(see RA 29957)



- The amplifier may only be unplugged when switched off!
- Measurements to be made with a high resistance meter set on the voltage range!
- Measured (control) zero (M 0) is raised + 9 V with respect to 0 V of the power supply!
- M 0 may NOT be connected to 0 V of the power supply!
- The »earth« sign of the inductive positional transducer may NOT be connected to (0 V) of the supply voltage!
- Radio transmitter may not be placed within 3.6 Ft (1M) of this card!
- Command level inputs may only be switched with dry contact switches suitable for currents of < 1 mA.
- Screen all input lines. Leave one end of the screen open. Connect one end to 0 V of the supply line!
- Do not lay solenoid lines close to power lines!

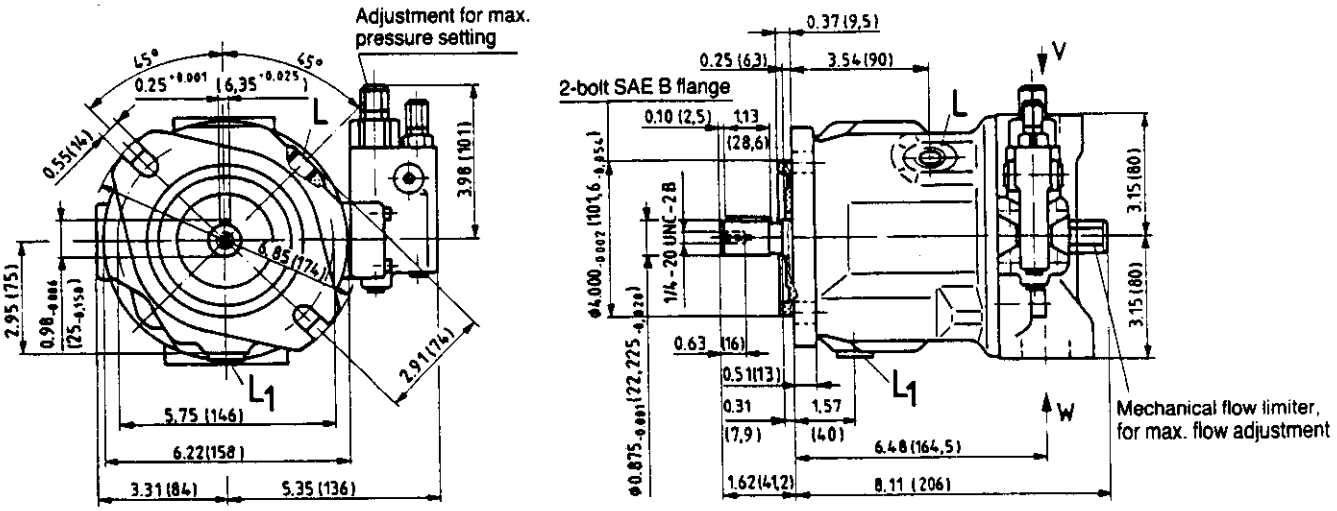
Dimensions

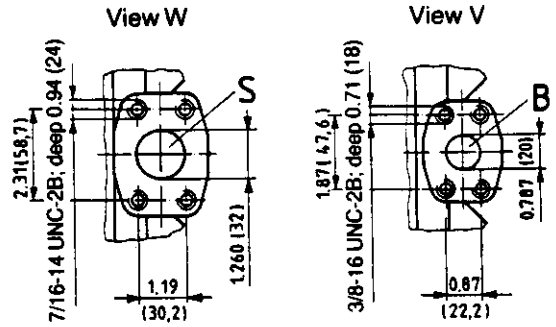


Unit dimensions, Size 28

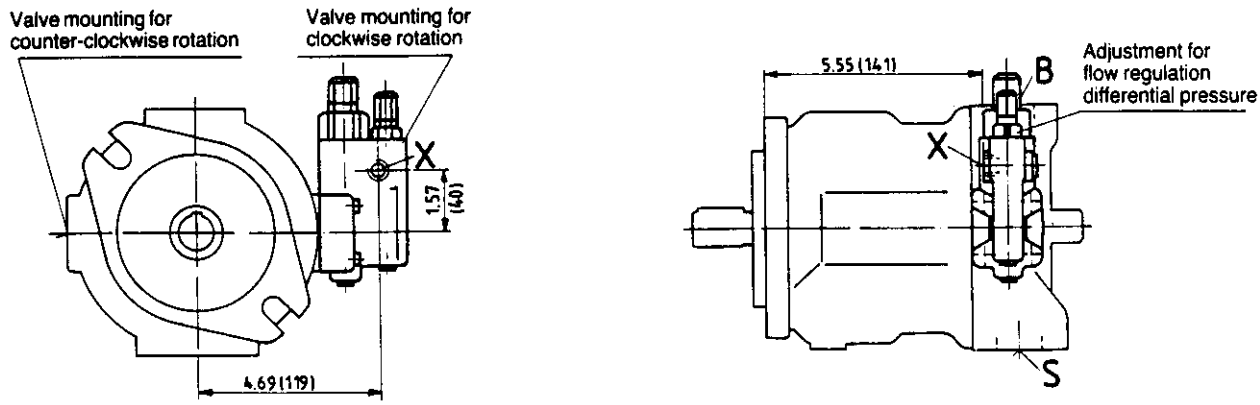
Model **N00** (without through drive)

Constant pressure compensator DR

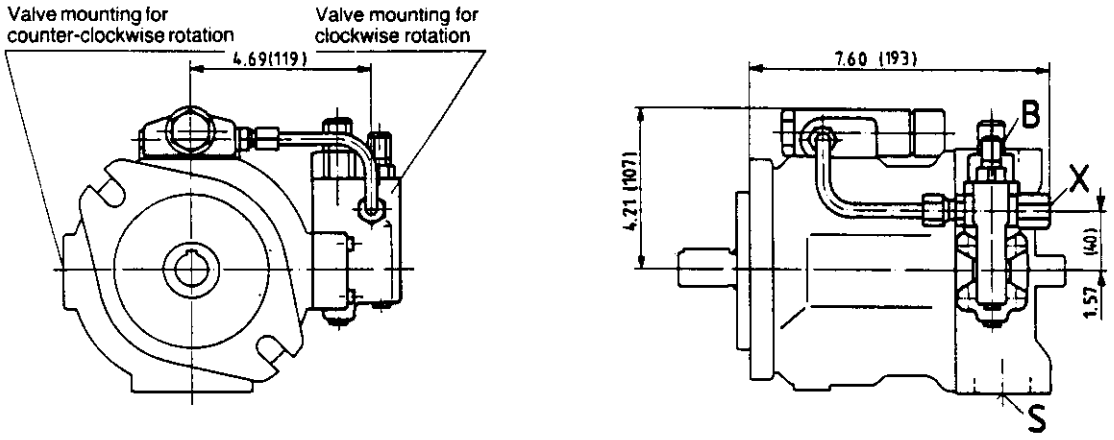




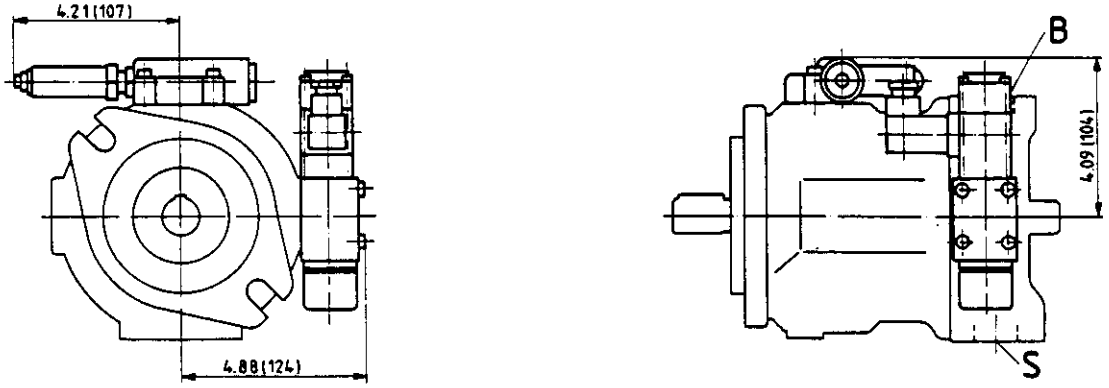
Constant pressure/flow compensator DFR



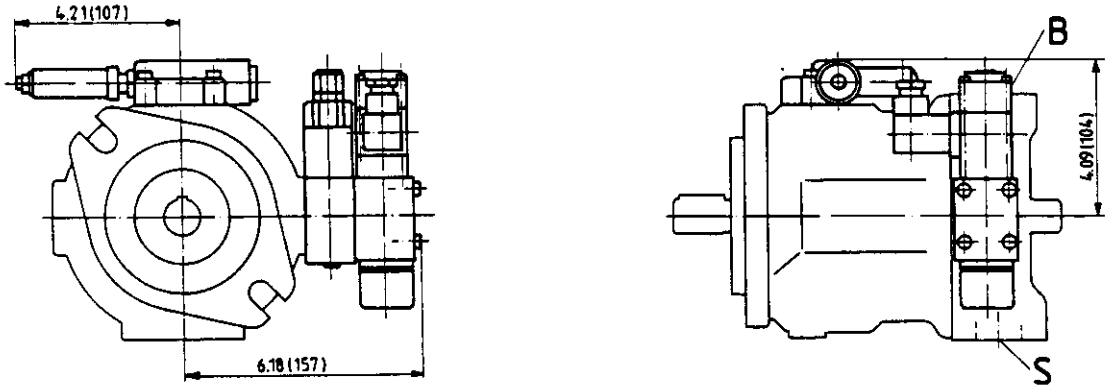
Constant pressure/flow/power control DFLR



Electrical flow control FE



Electrical flow control with pressure compensation FED



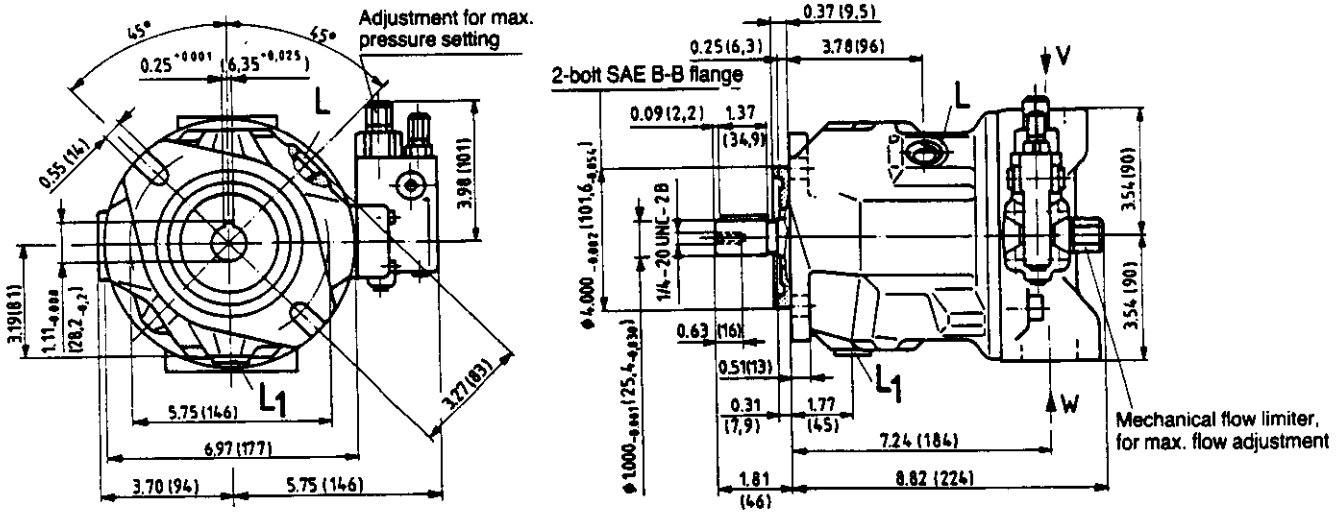
Port connections

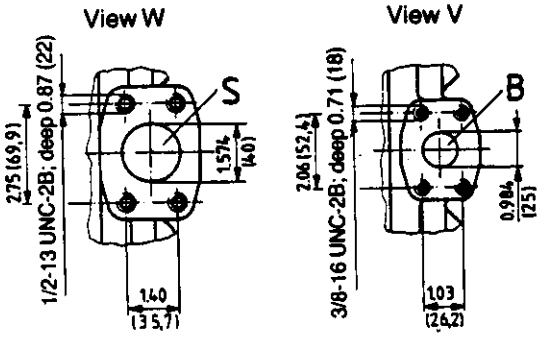
B	pressure port:	3/4" SAE flange (standard pressure range)
S	suction port:	1 1/4" SAE flange (standard pressure range)
X	pilot pressure port:	(for DFR and DFLR) 7/16-20 UNF-2B; deep 0.39(10)
L, L_1	case draining ports:	3/4-16 UNF-2B

Unit dimensions, Size 45

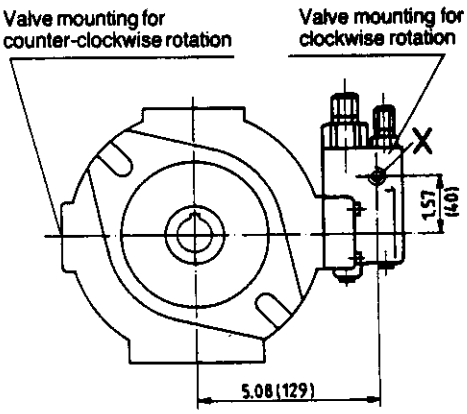
Model **N00** (without through drive)

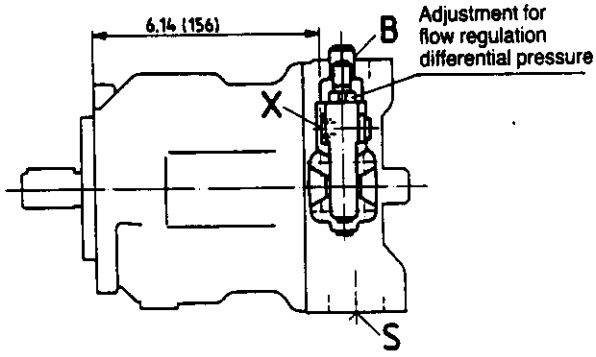
Constant pressure compensator DR



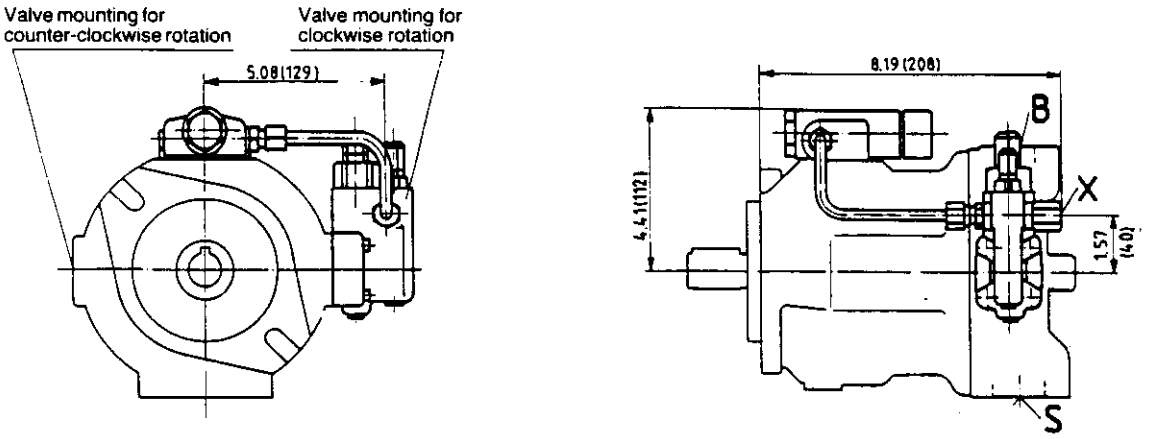


Constant pressure/flow compensator DFR

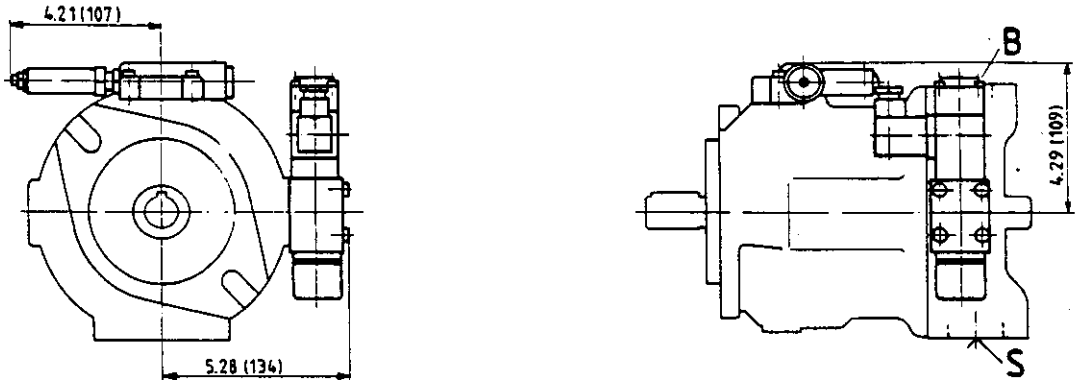




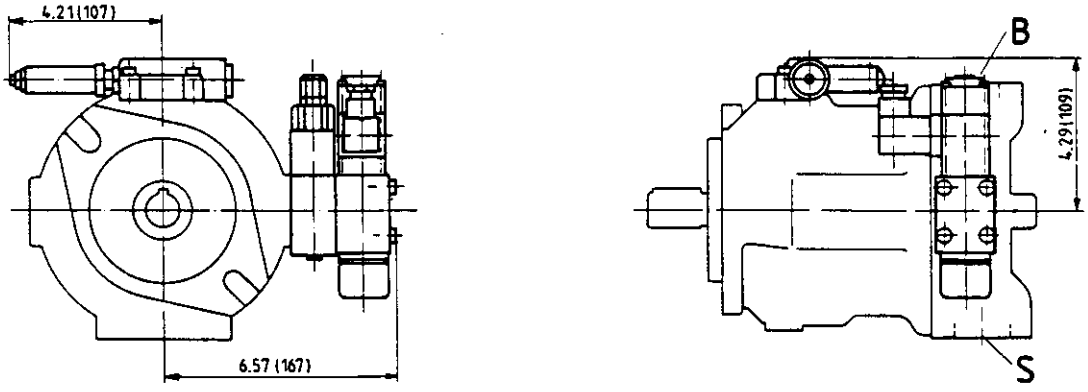
Constant pressure/flow/power control DFLR



Electrical flow control FE



Electrical flow control with pressure compensation FED



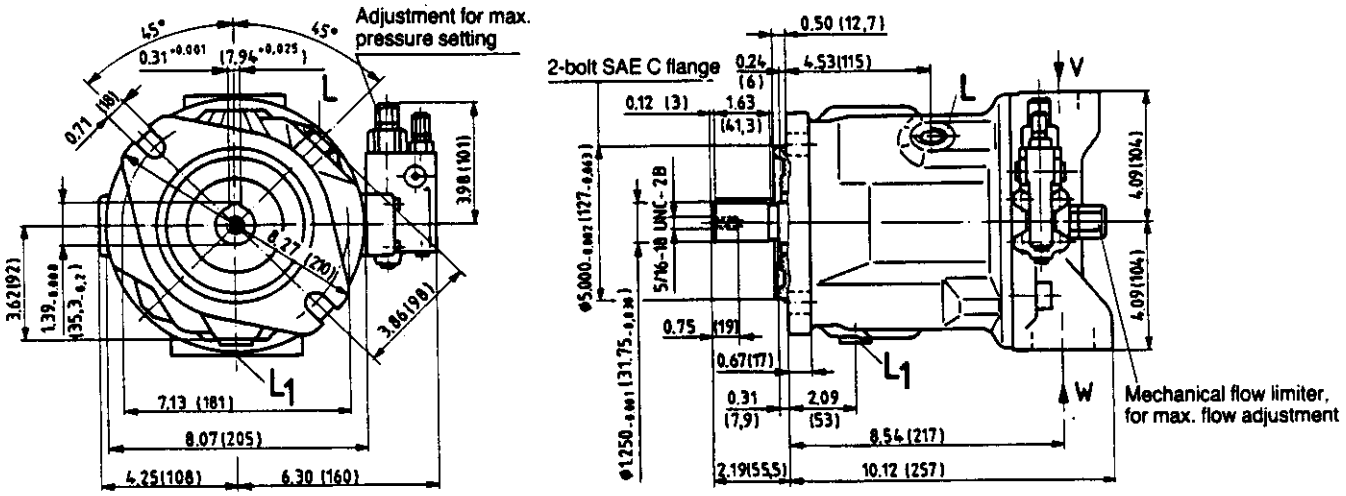
Port connections

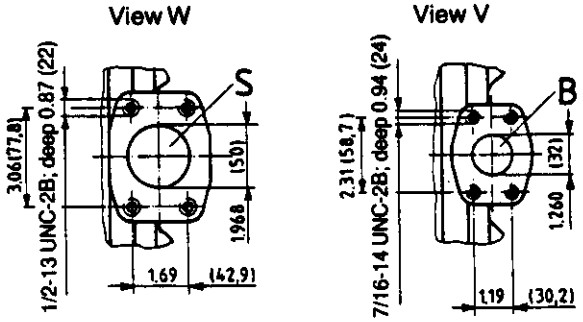
B	pressure port:	1" SAE flange (standard pressure range)
S	suction port:	1 1/2" SAE flange (standard pressure range)
X	pilot pressure port:	(for DFR and DFLR) 7/16-20 UNF-2B; deep 0.39(10)
L, L_1	case draining ports:	7/8-14 UNF-2B

Unit dimensions, Size 71

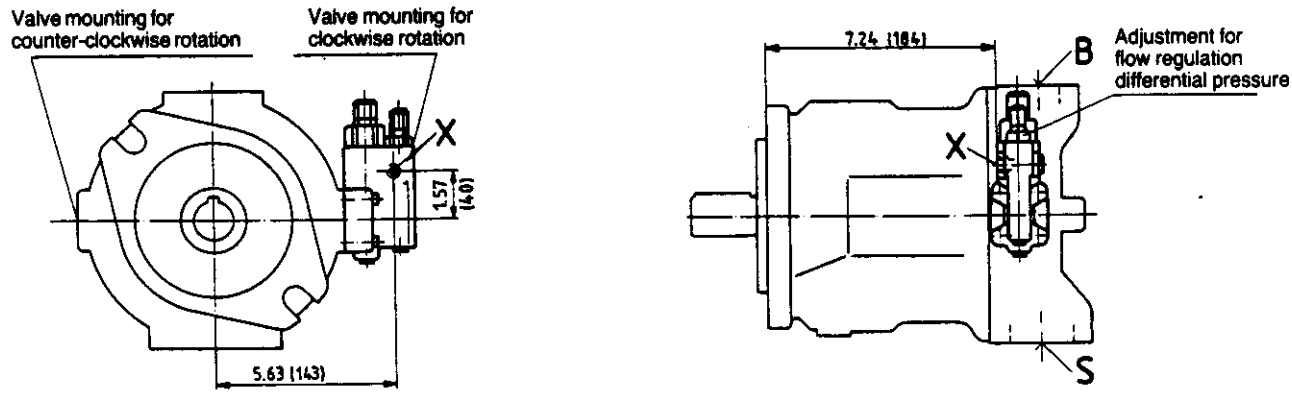
Model **N00** (without through drive)

Constant pressure compensator DR

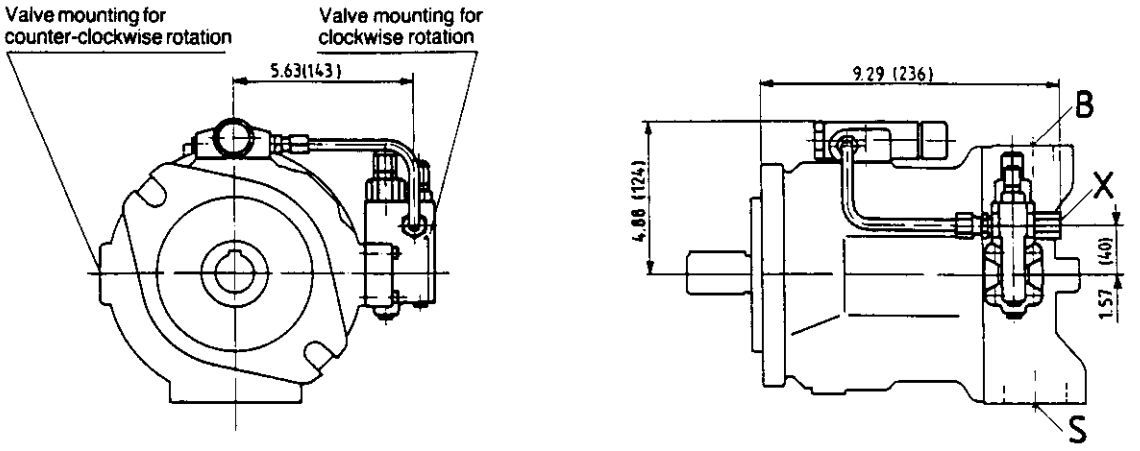




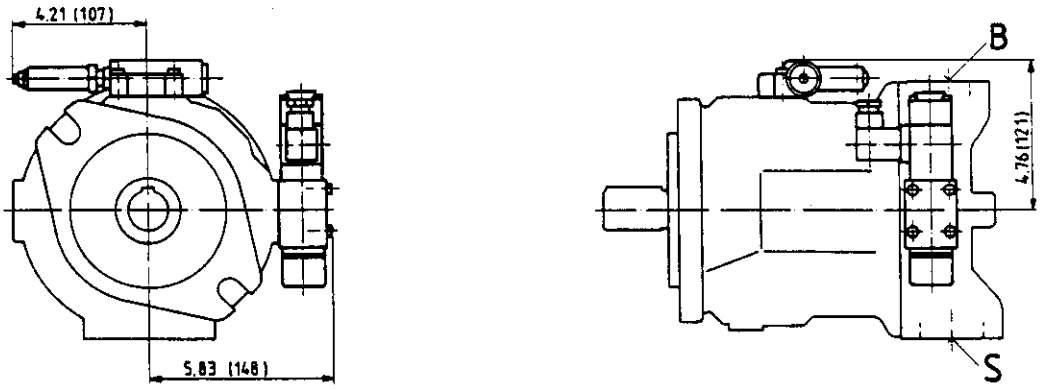
Constant pressure/flow compensator DFR



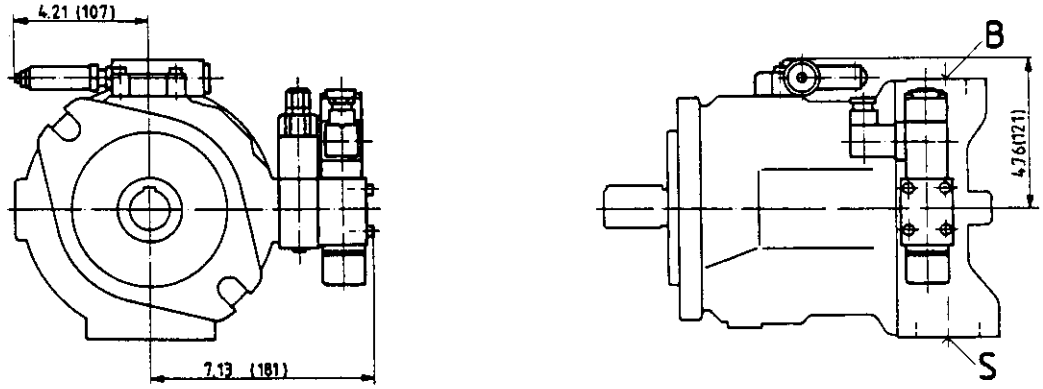
Constant pressure/flow/power control DFLR



Electrical flow control FE



Electrical flow control with pressure compensation FED



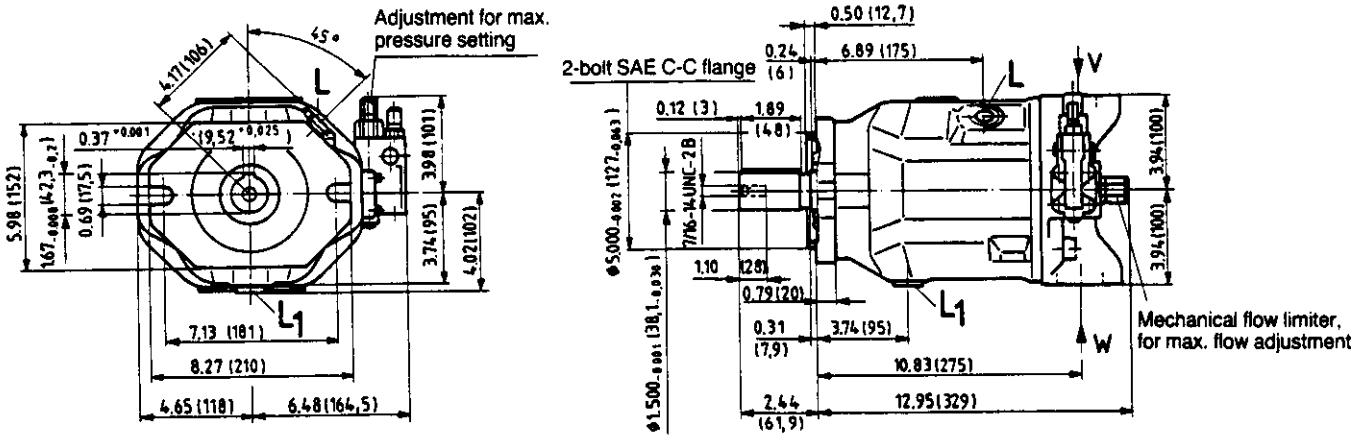
Port connections

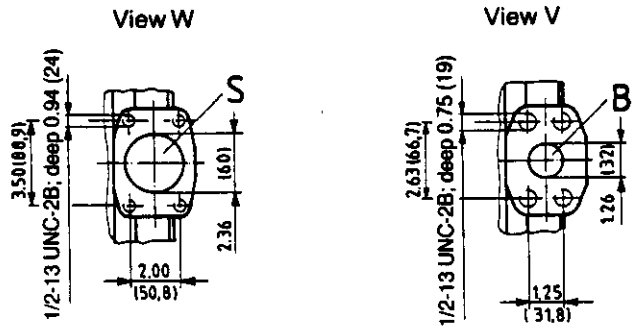
B	pressure port:	1 1/4" SAE flange (standard pressure range)
S	suction port:	2" SAE flange (standard pressure range)
X	pilot pressure port:	(for DFR and DFLR) 7/16-20 UNF-2B; deep 0.39(10)
L, L_1	case draining ports:	7/8-14 UNF-2B

Unit dimensions, Size 100

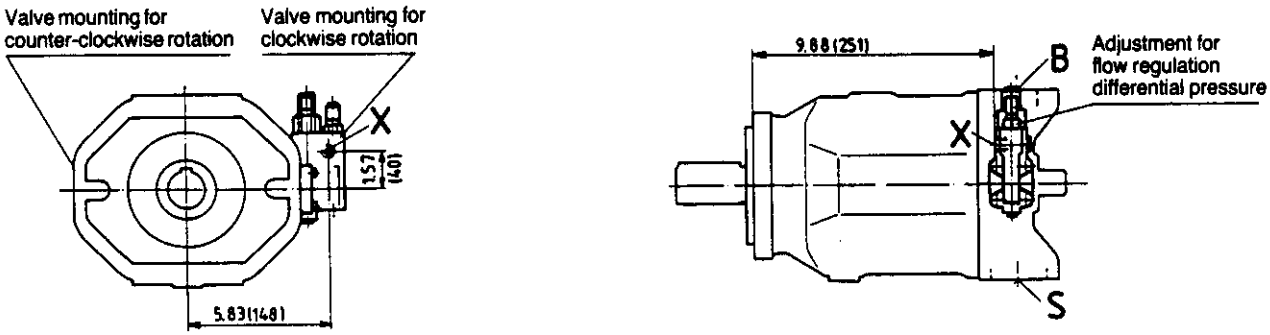
Model **N00** (without through drive)

Constant pressure compensator DR

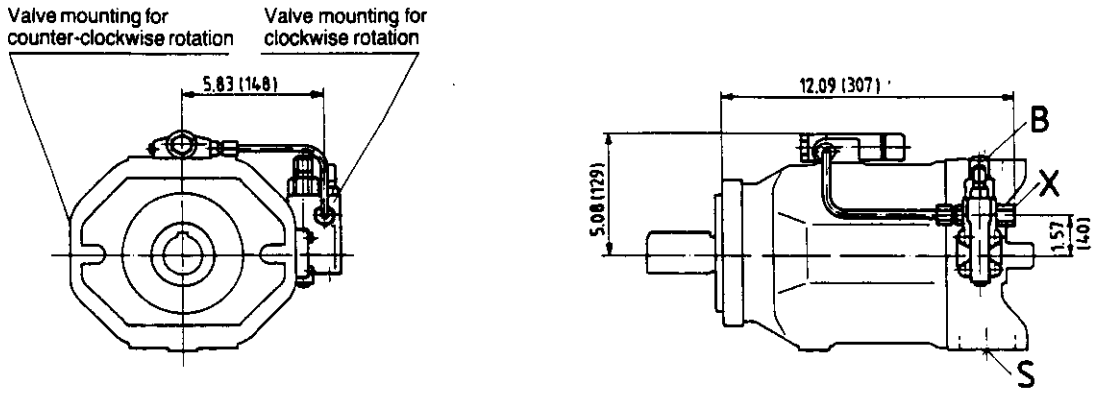




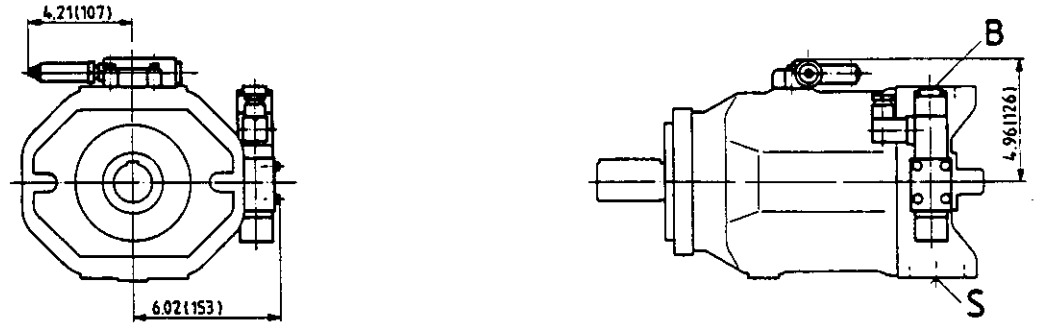
Constant pressure/flow compensator DFR



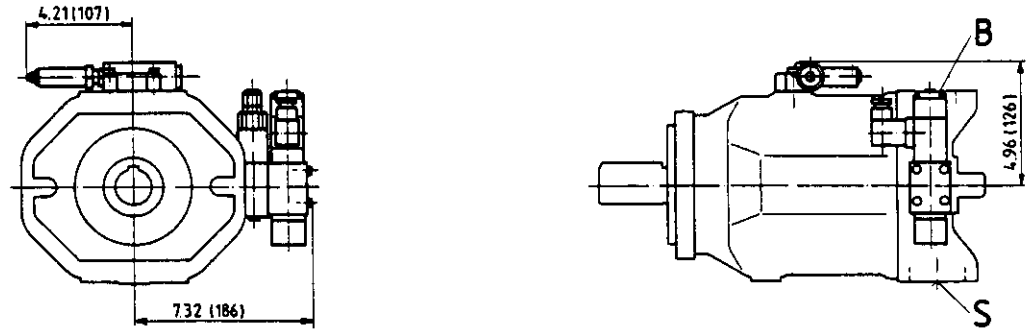
Constant pressure/flow/power control DFLR



Electrical flow control FE



Electrical flow control with pressure compensation FED



Port connections

B	pressure port:	1 1/4" SAE flange (6000 PSI, flange)
S	suction port:	2 1/2" SAE flange (standard pressure range)
X	pilot pressure port:	(for DFR and DFLR) 7/16-20 UNF-2B; deep 0.39(10)
L, L_1	case draining ports:	7/8-14 UNF-2B

Through Drive

Axial piston unit AA10VSO may be supplied with a through drive, as indicated in the ordering code page 2.

The Through Drive is determined by index (K01 – K08).

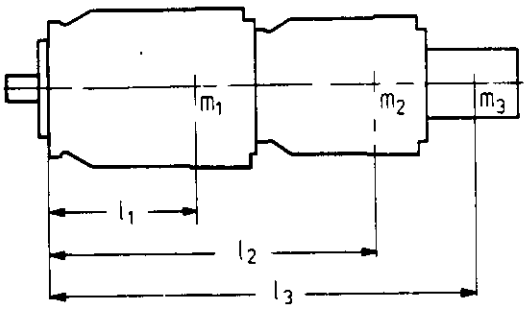
If the combination pumps are assembled in the factory, the ordering code consists of the individual pump codes connected by »+« signs.

Ordering Example:
AA10VSO 71 DR/30 R – PPA12K25 +
AA10VSO 28 DR/30 R – PPA12N00

If the second pump has not to be delivered resp. mounted, the simple type code is sufficient. The coupling, the seal and the fixing screws are a part of the delivery.

We recommend that no more than three individual pumps are coupled in series.

Permissible bending moment at mounting flange



$M_m = m_1 \times l_1 + m_2 \times l_2 + m_3 \times l_3$

Size			28	45	71
Bending Moment	M_m	lb-ft (Nm)	101 (137)	159 (216)	253 (343)
Weight (approx.)	M_1	lbs (kg)	33 (15)	46 (21)	73 (33)
Distance to center of gravity	l_1	in (mm)	4.33 (110)	5.12 (130)	5.91 (150)

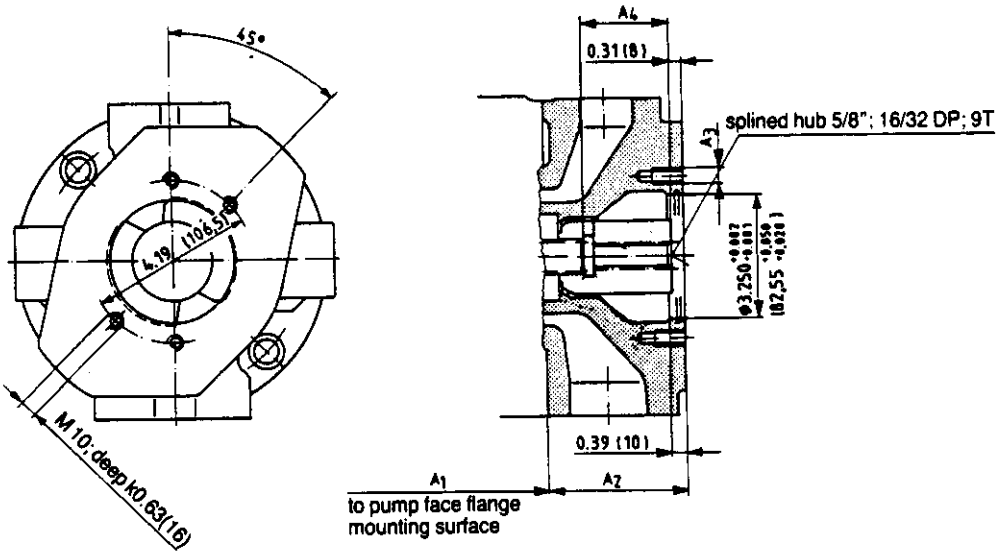
Permissible through drive torque

Size			28	45	71
Through drive torque*	M_D	lb-ft (Nm)	33 (45)	52 (70)	81 (110)

* assuming max. torque through the primary pump

Unit dimensions

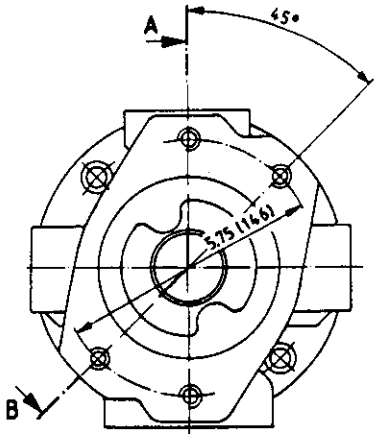
SAE A for mounting of secondary pump, order code **K01**



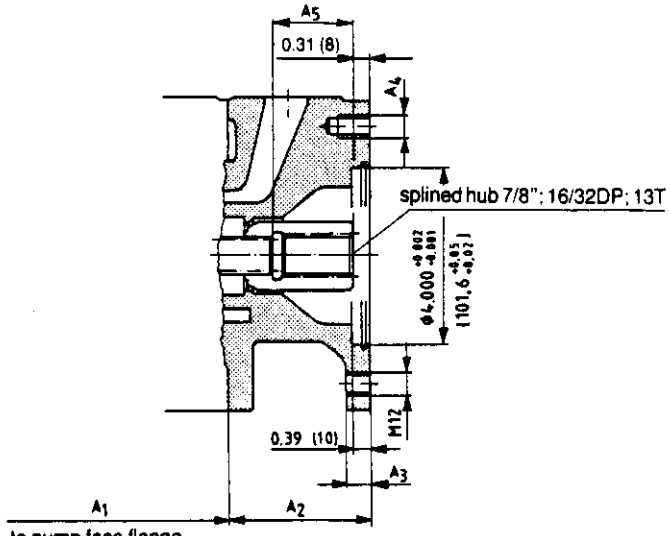
Size	A_1	A_2	A_3	A_4
28	5.268 (133.8)	2.76 (70)	M10; deep 0.63 (16)	1.49 (38)
45	5.858 (148.8)	3.15 (80)	M10; deep 0.63 (16)	1.73 (44)
71	6.960 (176.8)	3.54 (90)	M10; deep 0.79 (20)	2.05 (52)

SAE B for mounting of secondary pump,
order code **K02**

primary pump sizes 45 and 71

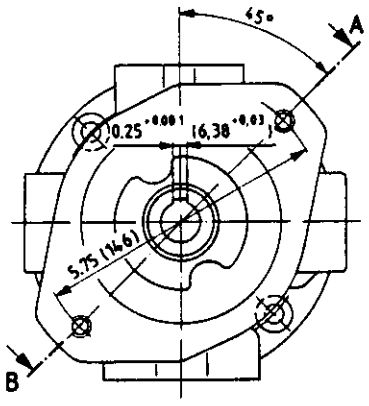


cutaway A – B

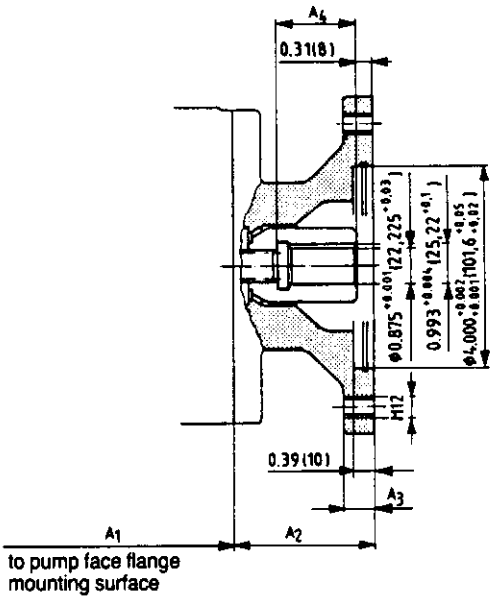


Size	A_1	A_2	A_3	A_4	A_5
45	5.858 (148.8)	3.15 (80)	0.55 (14)	M12; deep 0.71 (18)	1.73 (44)
71	6.960 (176.8)	3.54 (90)	0.71 (18)	M12; deep 0.79 (20)	2.05 (52)

Mounting of an AA10VSO 28;
order code **K 03**



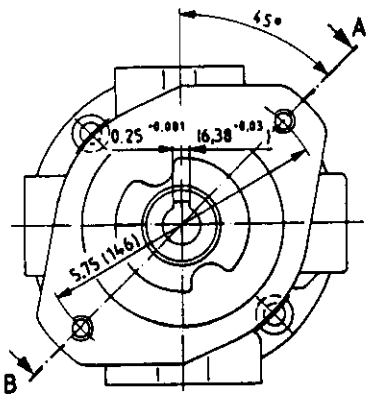
cutaway A – B



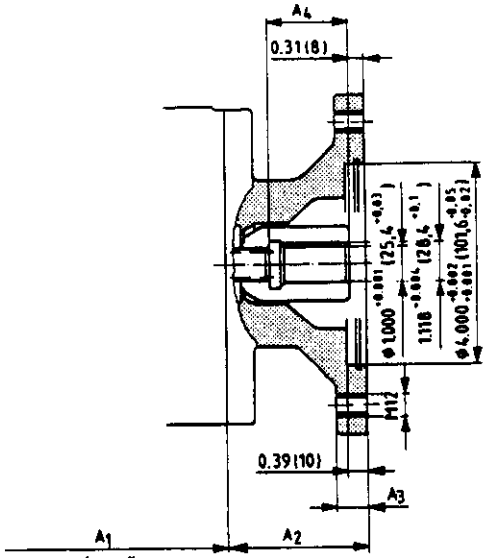
Size	A_1	A_2	A_3	A_4
28	5.268 (133.8)	2.76 (70)	0.59 (15)	1.49 (38)
45	5.858 (148.8)	3.15 (80)	0.55 (14)	1.73 (44)
71	6.960 (176.8)	3.54 (90)	0.71 (18)	2.05 (52)

Mounting of an AA10VSO 45;
order code **K 05**

primary pump sizes 45 and 71



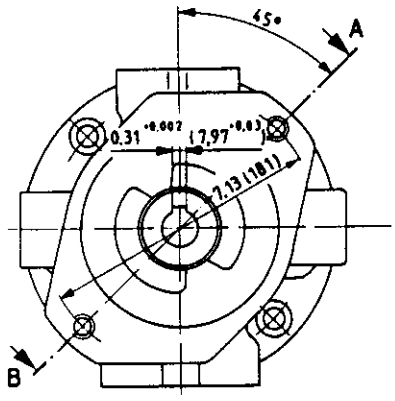
cutaway A – B

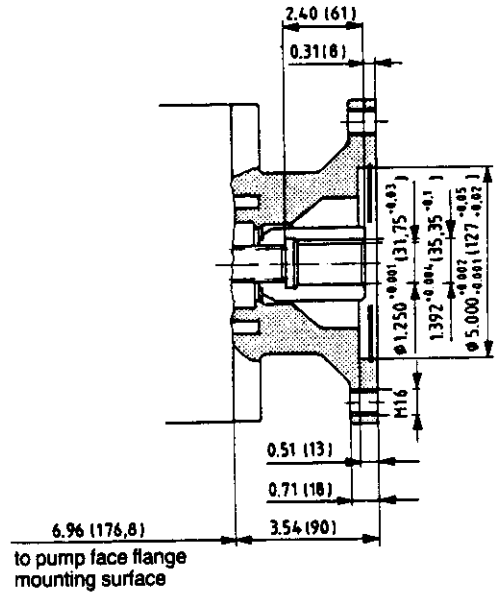


Size	A_1	A_2	A_3	A_4
45	5.858 (148.8)	3.15 (80)	0.55 (14)	1.73 (44)
71	6.960 (176.8)	3.54 (90)	0.71 (18)	2.05 (52)

Mounting of an AA10VSO 71;
order code **K 08**
primary pump size 71

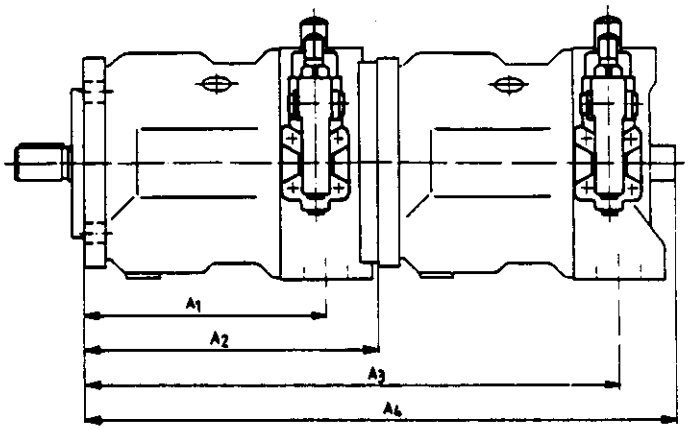
cutaway A – B





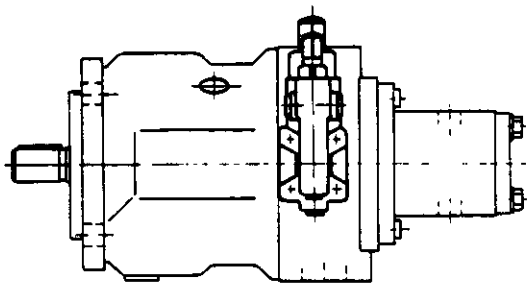
Unit dimensions, combination pumps

AA10VSO + AA10VSO



Primary pump / secondary p.	AA10VSO 28				AA10VSO 45				AA10VSO 71			
	A_1	A_2	A_3	A_4	A_1	A_2	A_3	A_4	A_1	A_2	A_3	A_4
AA10VSO 28	6.46 (164)	8.03 (204)	14.49 (368)	16.14 (410)	7.24 (184)	9.02 (229)	15.47 (393)	17.13 (435)	8.54 (217)	10.51 (267)	16.97 (431)	18.62 (473)
AA10VSO 45	–	–	–	–	7.24 (184)	9.02 (229)	16.26 (413)	17.83 (453)	8.54 (217)	10.51 (267)	17.76 (451)	19.13 (491)
AA10VSO 71	–	–	–	–	–	–	–	–	8.54 (217)	10.51 (267)	19.06 (484)	20.63 (524)

AA10VSO + Gearpump*



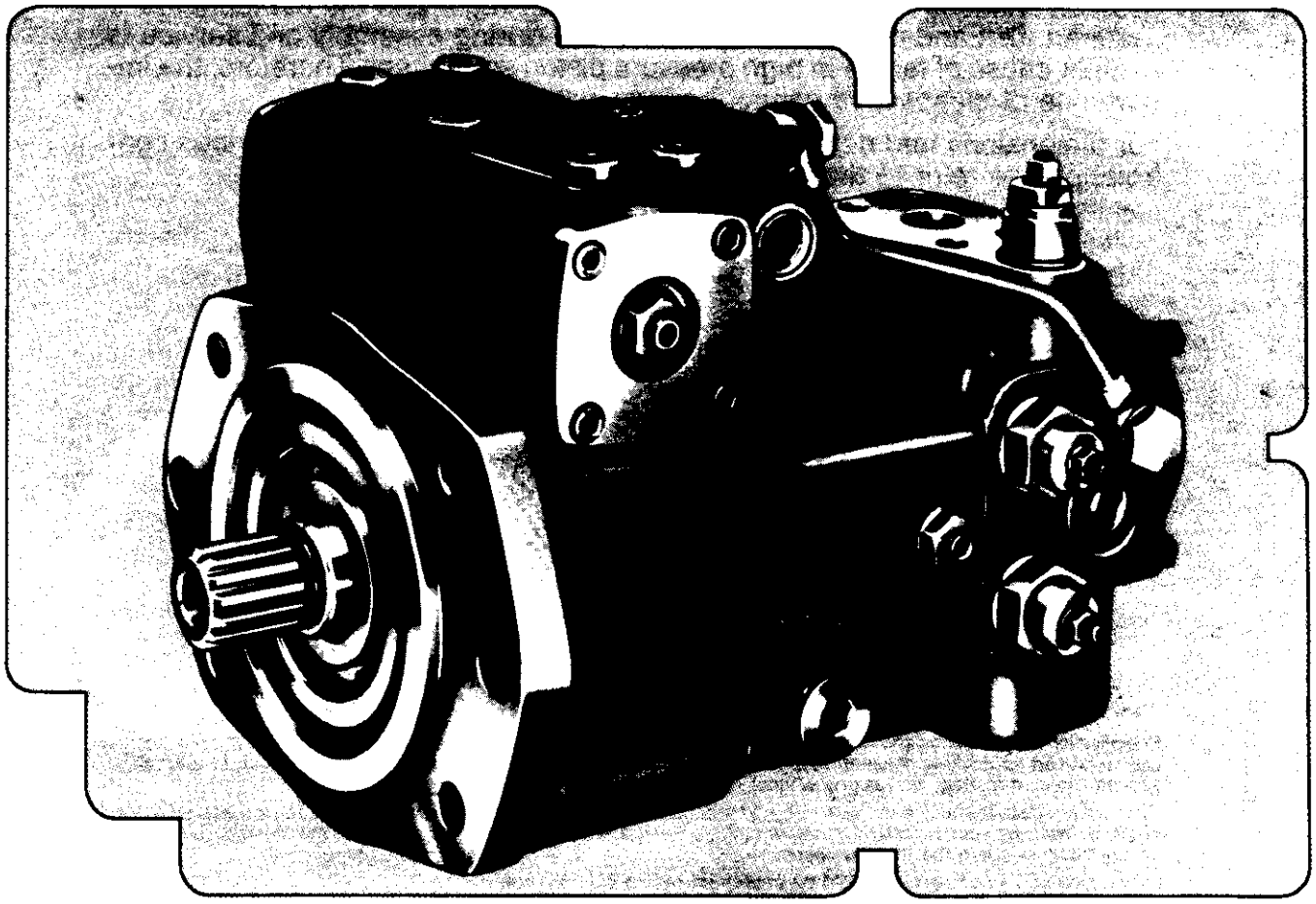
*Specify complete pump code see page 2

THE REXROTH CORPORATION
INDUSTRIAL HYDRAULICS DIVISION, P.O. Box 2407, 2315 City Line Road, Bethlehem, PA 18017-2131, Phone (215) 694-8300, Telex 84-7498
MOBILE HYDRAULICS DIVISION, P.O. Box 394, 1700 Old Mansfield Road, Wooster, OH 44691-0394, Phone (216) 263-3400, Telex 98-6335

REXROTH
WORLDWIDE HYDRAULICS

Applications and Service Manual

AA4V SERIES 1
Hydrostatic
Transmission
Pump



RA 06710/09.90
Replaces: 06.89

INTRODUCTION

This manual is intended to provide the information required to successfully start up, adjust, troubleshoot and service the Rexroth hydrostatic transmission pump, type AA4V Series 1.

The adjustment and disassembly procedures described herein may be performed in clean conditions without affecting the warranty. Dismantling the units beyond the stages described in the manual without the express permission of Rexroth may void the warranty.

When performing any type of service or conversion to these pumps, the utmost cleanliness of work area, tools, cleaning rags, and the components is required. Dirt and contamination introduced during assembly and service is a major cause of failure in high pressure piston equipment. Therefore, the importance of cleanliness cannot be over emphasized.

For dimensions and detailed descriptions of the function of the various controls, please refer to the relevant "RA" engineering data sheet.

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Specifications, descriptions and illustrative material shown herein were as accurate as known at the time this publication was approved for printing. Rexroth reserves the right to discontinue models or options at any time or to change specifications, materials, or designs without notice and without incurring obligation.

Optional equipment and accessories may add additional cost to the basic unit, and some options are available only in combination with certain models or other options. For the available combinations refer to the relevant data sheets for the basic unit and the desired option.

Information contained herein should be confirmed before placing orders.

Index

Type Code

AA4V	56	EL	1	R	3	0	2	0	1	0	/12VDC-TP-CV

Model

Axial Piston, Variable Displacement Pump — AA4V

Size

2.44 in³/rev 40 cm³/rev	40
3.42 in³/rev 56 cm³/rev	56
5.49 in³/rev 90 cm³/rev	90
7.63 in³/rev 125 cm³/rev	125

Controls

Remote hydraulic pilot	HD
Manual rotary servo	HW
Proportional electric	EL
Non-proportional electric	EL/NP
Without control module	OV
Without control module with P.O.R.	HM

Design Series No.

Sizes, 40, 56, 90, & 125	1

Direction of Rotation

Right hand (clockwise)	R
Left hand (counter-clockwise)	L

(As viewed at shaft end)

Mounting Configuration

Sizes 40 and 56, SAE 'C' 2-bolt Flange, 14T, 12/24 Pitch, 30° Involute, Tol. CL.5, Spline Shaft. ANSI B92.1a	3
Size 90 SAE 'D' 2-bolt Flange, 14T, 12/24 Pitch, 30° Involute, Tol. CL.5, Spline Shaft. ANSI B92.1a	3
Size 125, SAE 'D' 2-bolt Flange, 13T, 8/16 Pitch, 30° Involute, Tol, CL.5, Spline Shaft. ANSI B92.1a	3

**Refer to the relevent data sheet for torque limitations and dimensional details of through drive

Model Number Example—AA4V56EL 1R302010/12VDC-TP-CV

Variable displacement hydrostatic transmission pump, type AA4V, size 56, remote proprotional electric control (12VDC), series 1, right-hand rotation, SAE 'C' mounting flange, 14 teeth—12/24 pitch, spline shaft, porting for external charge flow filter, relief valve adjustment range of 2600 to 6000 psi, without pressure override, tamper-proof caps on adjustment screws and with high pressure shuttle checks.

Additional Information

(In clear text)

1) For EL control, advise required control voltage. Standard = 24 VDC Volts DC Optional = 12 VDC Volts DC
2) For tamper-proof caps on adjustment screws show TP.
3) For P.O.R. checks but without the P.O.R. show CV.
4) For neutral start switch (HW control only) show NSS.
5) For larger charge pump (size 40 only) show LCP.
6) For viton shaft seal show V.
7) For auxiliary Y-Port for remote inching show Y.

Pressure Override (P.O.R.) Option

Without pressure override	0
With pressure override (pressure override is standard with HM control)	1

High Pressure Relief Valves

With pilot-operated relief valves adjustable in range of 2600 to 6000 psi (standard design)	1
With pilot-operated relief valves adjustable in range of 1160 to 2600 psi.	2

Speed Sensing Horsepower Limiter

For use with diesel or gasoline engines only. Not available with OV control.

Without S.S.H.L. control cartridge (standard design)	0

For S.S.H.L. see brochure RA06202

Filter Port Options

With porting for suction filter only (standard)	1
With porting for external charge flow filter (If external charge flow filtration is required with S.S.H.L., contact Rexroth for details)	2
With direct mounted filter (supplied with AA4V) Contact Rexroth for details and availability	5

Through Drive For Auxiliary Pump**

Without through drive for auxiliary pump	0
Without charge pump & without through drive	E
With charge pump & SAE A, 2-bolt through drive	C
With charge pump & SAE B, 2-bolt through drive	G
With charge pump & SAE B-B, 2-bolt through drive	J
With charge pump & SAE C, 2-bolt through drive. Size 90 & 125 only.	M

General Specifications AA4V Pump

SPECIFICATION	Unit	AA4V40	AA4V56	AA4V90	AA4V125
Displacement	in³/rev	2.44	3.42	5.49	7.63
	cm³/rev	40	56	90	125
Nominal flow at 1000 rpm	gpm	10.56	14.80	23.77	33.00
	l/min	40	56	90	125
Maximum pressure	psi	6000	6000	6000	6000
	bar	414	414	414	414
Torque constant	lb ft/100 psi	3.23	4.53	7.28	10.12
	Nm/bar	0.639	0.89	1.44	1.99
Maximum allowable shaft torque	lb ft	305	381	473	1007
	Nm	414	517	641	1367
Maximum drive speed	rpm	3700	3400	2900	2600
Minimum drive speed	rpm	500	500	500	500
Weight (approx. varies with control type)	lbs	64	77	112	154
	kg	29	35	51	70
Moment of Inertia	lb-in²	16.72	29.01	59.73	102.4
	kgm²	0.0049	0.0085	0.0175	0.03
Maximum case pressure	psi	29	29	29	29
	bar	2	2	2	2
Maximum permissable external loading of the drive shaft	F_A lbs	337	494	786	1078
	N	1500	2200	3500	4800
	F_R lbs	809	1124	1798	2472
	N	3600	5000	8000	11,000

Charge Pump

Displacement	in³/rev	0.51	0.70	1.16	1.61
	cm³/rev	8.4	11.6	19.0	26.4
Nominal flow at 1000 rpm	gpm	2.20	3.03	5.02	6.97
	l/min	8.4	11.4	19.0	26.4
Nominal pressure	psi	320	320	320	320
	bar	22	22	22	22
Maximum pressure	psi	580	580	580	580
	bar	40	40	40	40
Minimum inlet pressure (at normal operating temp.)	psig	−3.2	−3.2	−3.2	−3.2
	bar(absolute)	0.8	0.8	0.8	0.8

Installation....the AA4V pump may be mounted in any position around the horizontal axis. The horizontal axis (drive shaft) may be tilted to 15° in either direction from the horizontal.

The AA4V transmission pump is usually face-mounted to a drive gear box with the shaft engaging a mating female splined gear hub, or spline adapter. The large drive shaft bearings permit the pump to be driven by vee or toothed belt drives. The case drain line should be connected to the highest case drain port (T_1 or T_2) so that the pump case always remains full of oil. The case drain return piping, or hose, should be sized to accept the full flow of the charge pump at the maximum anticipated drive speed.

For mobile applications, the oil reservoir capacity required (in US gallons) is generally .75 to 1 times the charge pump flow (in US gallons per minute) for a one pump, one motor transmission. The heat exchanger should be located between the pump case drain and the reservoir, and sized to accept the full flow of the charge pump at the maximum anticipated drive speed.

To accommodate slight shaft misalignment and to dampen vibration, use of a flexible coupling is recommended. The pump user should work closely with the coupling manufacturer in selecting and applying a suitable coupling. When flexible couplings, gear, Vee-belts or toothed timing belts are to be used, the coupling half, gear, or pulley, should be secured to the drive shaft using a spacer between the coupling and the shoulder on the drive shaft, and locking the coupling to the shaft by using a set screw in the threaded hole in the end of the shaft. If this is not possible, as when mounting the motor to a drive gearbox, Optimoly Paste White T multi-purpose lubricating paste or equivalent MUST be applied to the shaft to avoid fretting corrosion of the spline.

Flushing Circuit....When one variable pump and one motor is used, a flushing valve is not normally required unless continuous high speed and/or high pressure is anticipated. In this case, flushing may be required through the motor case as well as the pump case (see note below).

Whenever any type of valves, such as directional control valves or flow divider valves, are used in the closed loop circuit, a system flushing valve is recommended.

NOTE: All charge pump flow must pass through the pump case when the transmission is in neutral and the pump is rotating. If a circuit flushing valve (hot oil shuttle valve) is used, the outlet port of this valve must be connected to the lower case drain port of the pump.

Filtration....There are three options available for the filtration of the hydraulic fluid used in the AA4V pump.

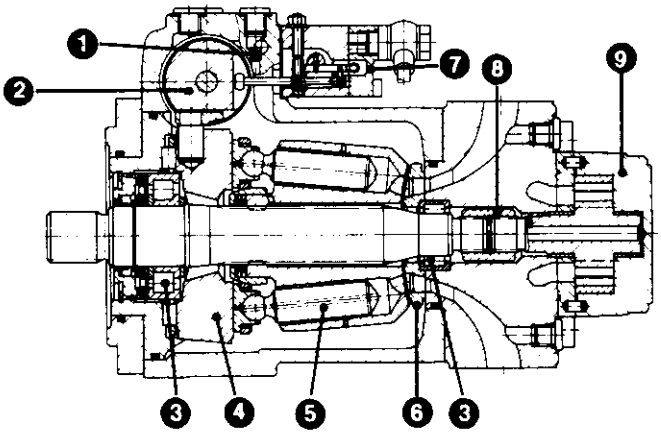
See Page 9 for detailed descriptions.

Fluid Recommendations....the AA4V pumps are supplied as standard for use with good quality, petroleum-based, hydraulic fluids.

See Page 23 for fluid characteristics and fluid viscosity ranges.

Operating Temperature.... −13°F to +195°F (−25°C to 90°C). The temperature level of a particular system is normally measured at the pump or motor case drain. This temperature is then used to establish the cooling requirements for the system.

Design Features AA4V Pump



1. Stroking time orifice (2 per pump)
2. Control piston
3. Heavy-duty roller bearings
4. Rocker cam swashplate
5. Inclined pistons
6. Spherical control plate
7. Control module
8. Spline coupling
9. Internal gear charge pump

Control Descriptions

Remote Hydraulic Pilot Control, Type HD

The flow output of the pump is infinitely varied in the range of 0 to 100%, proportional to a low pressure pilot signal, in the range of 85 to 260 psi, applied at port Y_1 or Y_2.

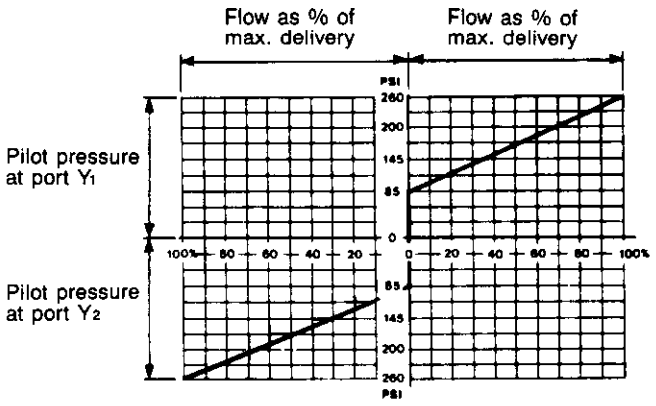
The pilot signal, which originates from an external, remote source, is pressure only. Flow is negligible as the pilot signal is only acting on the spool of the control valve.

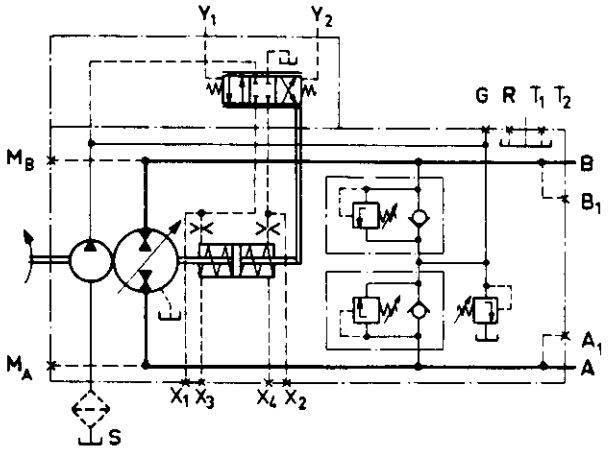
This spool then directs control oil in and out of the control cylinder to stroke the pump as required.

A feedback lever connected to the control piston maintains the pump flow for any given pilot signal.

With no command signal at Y_1 or Y_2, the control is in the neutral (zero flow) position preventing transmission output.

The Rexroth TH7 remote control, lever, and foot pedal-operated pilot valves, may be used directly with this pump control.





STANDARD STROKING TIMES		40	56	90	125
Zero to max. displ.	(sec)	1.0	1.0	1.2	1.2
Max. displ. to zero	(sec)	1.0	1.0	1.2	1.2
Orifice size	(mm)	0.8	0.8	1.0	1.0

Faster or slower stroking times are possible by changing the size of the stroking time orifices.

Manual Rotary Servo Control, Type HW

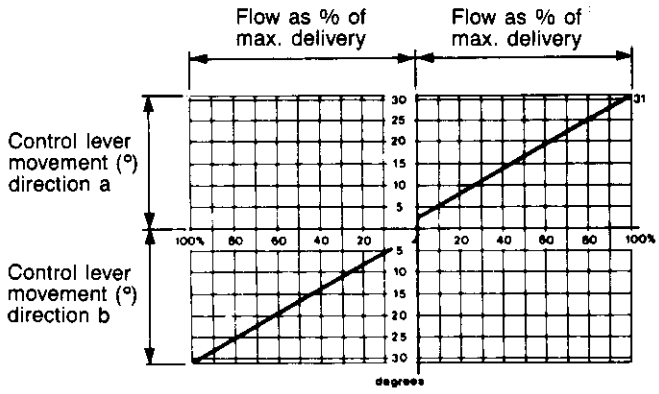
The flow output of the pump is infinitely varied in the range of 0 to 100%, proportional to the control lever between 0° and 31°.

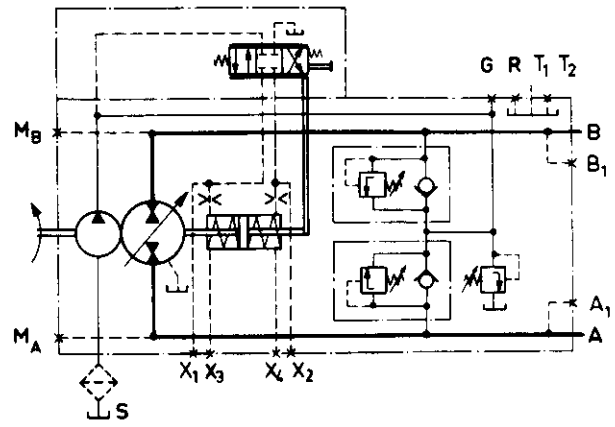
Flow from the pump is reversed by moving the lever from position 'a' to position 'b'.

A feedback lever connected to the control piston maintains the pump flow for any given position of the control lever between 0° and 31°.

The 'HW' control is suitable for use with push-pull cables and mechanical linkages; however, lever movement must be mechanically limited to prevent control damage.

The torque required to activate the control is 1.95 in lbs. (22 Ncm).





STANDARD STROKING TIMES		40	56	90	125
Zero to max. displ.	(sec)	1.0	1.0	1.2	1.2
Max. displ. to zero	(sec)	1.0	1.0	1.2	1.2
Orifice size	(mm)	0.8	0.8	1.0	1.0

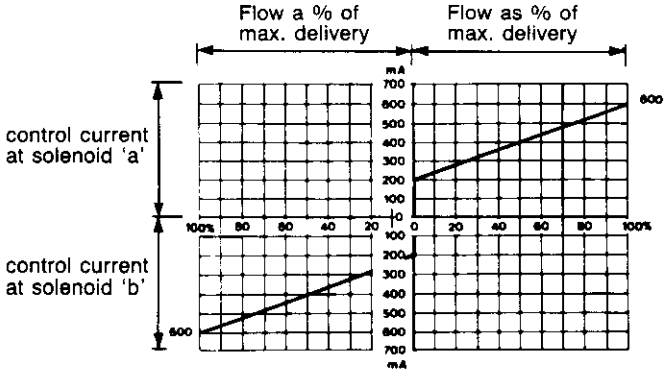
Faster or slower stroking times are possible by changing the size of the stroking time orifices.

Proportional Electric Control, Type EL

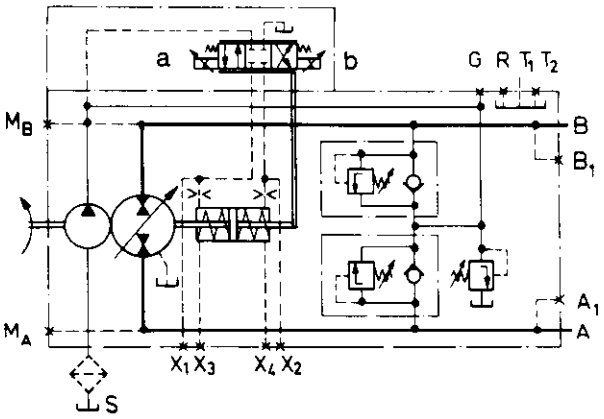
The flow output of the pump is infinitely varied in the range of 0 to 100%, proportional to an electrical current, in the range of 200 ± 10% to 600 ± 10% milliamps at 24 VDC, supplied to solenoid a or b. (A current of 400 ± 10% to 1200 ± 10% mA is required for the 12-volt solenoids)

The electrical energy is converted to a force acting on the control spool. The spool then directs control oil in and out of the control cylinder to stroke the pump as required. A feedback lever connected to the control piston maintains the pump flow for any given current within the control range. Even though this is a proportional control, the filtration requirement is the same as the total pump assembly.

Several Rexroth amplifiers may be used to provide the control current to solenoid a or b. The amplifier requires an external power supply of 12 or 24 VDC and can be remotely operated by means of a panel or joystick-mounted potentiometer.



24 VDC



STANDARD STROKING TIMES		40	56	90	125
Zero to max. displ.	(sec)	1.0	1.0	1.2	1.2
Max. displ. to zero	(sec)	1.0	1.0	1.2	1.2
Orifice size	(mm)	0.8	0.8	1.0	1.0

Faster or slower stroking times are possible by changing the size of the stroking time orifices. Also, stroking times may be varied by adjusting the ramp times on the amplifier.

Coil Resistance

Pump Size	Voltage	@ 20°C
40, 56, 90 & 125	12 VDC	6.2
	24 VDC	24.6

Coils require a 100 Hz. dither frequency with an amplitude of ± 300 mA for 12 VDC or ± 150 mA for 24 VDC.

Pump Without Control Module, Type OV

Pumps with ordering code OV have no control module. The module is replaced by a cover plate.

When a hydraulic pressure which is typically supplied by a remote hydraulic pilot control or pressure reducing valve is applied to the X_1 or X_2 port, the pump will come on stroke to produce a flow of oil out of either the A or B port. Pump displacment is determined by the resistance of the centering springs in the pump, the hydraulic pressure supplied at port X_1 or X_2, and the hydrostatic centering force of the rotary pump which is proportional to system pressure. This pump control is not a positive displacement control, since there is no feedback between the stroking piston and the control module.

Typical applications for an OV control are: a drive transmission in a vehicle where speed is continuously controlled by the operator and smooth acceleration and deceleration is a necessity, or for a swing control on a crane or excavator. Some examples of these applications are skidsteer loaders, industrial sweepers, municipal sweepers, railroad equipment, tow tractors, and lift trucks.

Control Characteristics

1. Control piston displacement from neutral to maximum swash angle of 15° in either direction.

Pump Size	40	56	90	125
Displacement in³ (cm³)	0.685 (11.23)	0.987 (16.18)	1.585 (25.97)	2.227 (36.5)

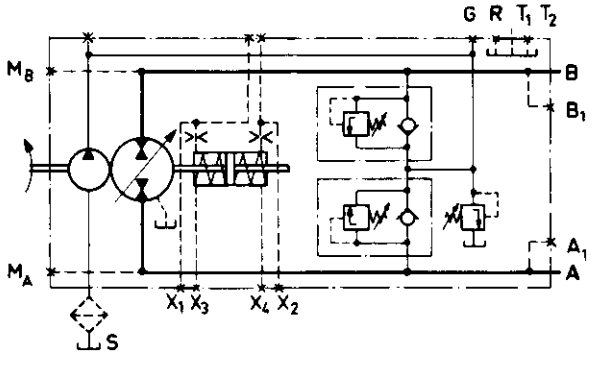
2. Standard stroking times when using ports X_1 and X_2.

Pump Size	40	56	90	125
Neutral to 15° swash angle	1.0	1.0	1.2	1.2
15° swash angle to neutral	1.0	1.0	1.2	1.2
Orifice size (mm)	0.8	0.8	1.0	1.0

Faster or slower stroking times are possible by changing the size of the stroking time orifices in ports X_1 and X_2.

3. Control pressure required at port X_3 or X_4 to begin stroking the pump against the centering springs with only charge pressure at port A and B = 87 psi (6 bar).
4. Control pressure required at port X_3 to X_4 to fully stroke the pump against the centering springs and hydrostatic centering forces at 5800 psi (400 bars) will be in the 320 psi (22 bar) to 400 psi (28 bar) range depending on pump size and drive speed.

NOTE: The pump swash angle for any given control pressure between 87 psi (6 bar) and 350 psi (24 bar) will be influenced by changes in system pressure at port A or B.



Control Descriptions

Pump Without Control Module With P.O.R., Type HM

CONTROL DESCRIPTION

The HM pump control provides the same type of displacement control as an OV, but also incorporates a pressure override valve. When a hydraulic pressure, which is typically supplied by a remote hydraulic pilot control or pressure reducing valve, is applied to the Y_1 or Y_2 port, the pump will come on stroke to produce a flow of oil out of either the A or B port. Pump displacement is determined by the resistance of the centering springs in the pump, the hydraulic pressure supplied at port Y_1 or Y_2, and the hydrostatic centering force of the rotary group which is proportional to system pressure. The pressure override valve (P.O.R.) varies the swashplate angle, as required, to limit the maximum system pressure at port A or B. The override valve prevents continuous dumping of excessive flow at load pressure through the cross port relief valves contained in the pump. This pump control is not a positive displacement control since there is no feedback between the stroking piston and the control module.

Typical applications for an HM control are: a drive transmission in a vehicle where speed is continuously controlled by the operator and smooth acceleration and deceleration is a necessity, or for a swing control on a crane or excavator. Some examples of these applications are skidsteer loaders, industrial sweepers, municipal sweepers, railroad equipment, tow tractors, and lift trucks.

Control Characteristics

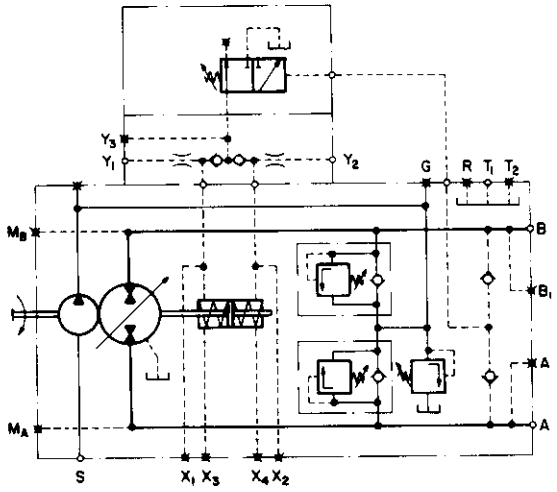
1. Standard stroking times when using ports X_1 or X_2

Pump Size	40	56	90	125
Neutral to 15° swash angle	1.0	1.0	1.2	1.2
15° swash angle to neutral	1.0	1.0	1.2	1.2
Orifice size (mm)	0.8	0.8	1.0	1.0

Faster or slower stroking times are possible by changing the size of the stroking time orifices in ports X_1 and X_2.

2. Control pressure required at port X_2 or X_4 to begin stroking t pump against the centering springs with only charge pressu at port A and B = 87 psi (6 bar).
3. Control pressure required at port X_3 or X_4 to fully stroke the pu against the centering springs and hydrostatic centering forc at 5800 psi (400 bar) will be in the 320 psi (22 bar) to 400 (28 bar) range depending on pump size and drive speed.

NOTE: The pump swash angle for any given control pressu between 87 psi (6 bar) and 350 psi (24 bar) will be fluenced by changes in system pressure at port A or



Optional Features

Through Drive for Auxiliary Pump

- Standard SAE A, B, B-B, and C 2-bolt mounting flanges
- Convenient location for additional pump
- Compact dimensions
- Rexroth steering pumps can be mounted to provide complete drive and steering package
- Through drive can be retrofitted in the field

Length of through drive adapter: ("b" dimension)

Through drive	Size	40	56	90	125
SAE A (Code C)		1.99	2.24	2.17	3.31
SAE B (Code G)		3.76	4.02	3.94	2.83
SAE B-B (Code J)		3.76	4.02	3.94	3.07
SAE C (Code M)				4.96	5.24

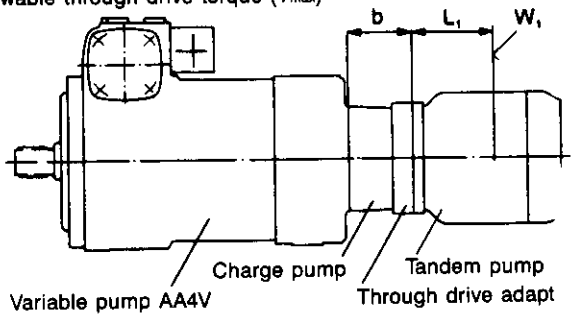
Maximum Allowable Through Drive Torque: T_{max} (lb-ft)

Through drive	Size	40	56	90	125
SAE A (Code C)		74	74	74	74
SAE B (Code G)		118	118	118	162
SAE B-B (Code J)		118	118	118	244
SAE C (Code M)				162	162

Refer to RA06204 for more information.

Charge Pump and Through Drive

Allowable moment of force (M_{max})
Allowable through drive torque (T_{max})



L_1 (inches) Distance to center of gravity of tandem pump

b (inches) Length of through drive adapter

W_1 (pounds) Weight of tandem pump

$$M = W_1 (L_1 + b) \frac{1}{12} \text{ (lb-ft.)}$$

Allowable Moment of Force: M_{max} (lb-ft)

Through drive	Size	40	56	90	12
SAE A (Code C)		38	38	38	7
SAE B (Code G)		37	37	37	7
SAE B-B (Code J)		37	37	37	7
SAE C (Code M)				162	12

Optional Features

FILTRATION

The fluid should be filtered prior to system start-up and continuously during operation to achieve and maintain a cleanliness level of ISO 18/15. (This corresponds approximately to NAS 1638 Class 9, or SAE [1963] Class 6.) This recommendation should be considered a minimum, as better cleanliness levels will significantly increase component life.

Each application should be analyzed to determine the proper method of filtration needed to maintain the required cleanliness levels, as contaminant generation and ingression can vary greatly, depending on the configuration and complexity of the system.

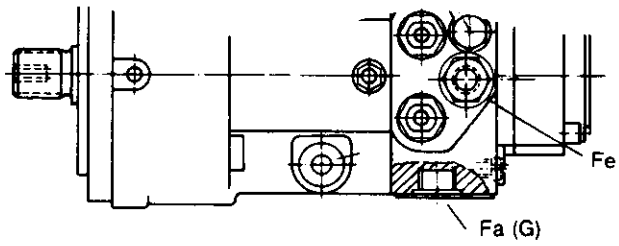
For particular system requirements, or for application outside these parameters, a Rexroth Applications Engineer should be consulted.

Ordering Code Option Number 1
With porting for suction filter only (standard design).

Fluid cleanliness level ..... ISO code 18/15
Pressure drop at filter element
at V = 141 SSU (30 cSt) and pump max speed ..... 1.5 psi (0.1 bar)
at V = 4600 SSU (1000 cSt) and 1000 rpm ..... 4.4 psi (0.3 bar)
Pressure at inlet port of charge pump
at V = 141 SSU (30 cSt) ..... −3 psig (0.8 bar)
on cold start ..... −7 psig (0.5 bar)

A suction filter without bypass and with clogging indicator is recommended.

Ordering Code Option Number 2*
With porting for external charge flow filter, this option is achieved by removing the plug in port Fe and replacing it with an adapter sleeve. This adapter sleeve allows all of the fluid from the charge pump to be passed through a customer-supplied, external, low pressure filter prior to being delivered into the closed loop circuit via port Fa (G).

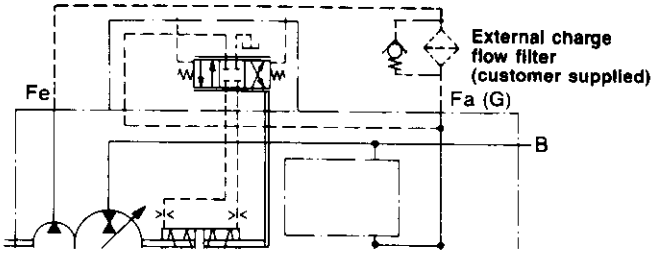


Filter Connection Port Sizes

Pump Size	40 & 56	90	125
Port Fe	7/8"-14 UNF	7/8"-14 UNF	1-1/16"-12 UNF
Port Fa (G)	7/8"-14 UNF	1-1/16"-12 UNF	1-1/16"-12 UNF

IMPORTANT

Never plug port Fe when the adapter sleeve is fitted as there will be no internal pressure protection for the charge pump.



CIRCUIT SCHEMATIC, OPTION NUMBER 2

Recommendations For External Charge Flow Filter
Fluid cleanliness level ..... ISO code 18/15
Pressure drop at filter element
at V = 141 SSU (30 cSt) ..... 14.5 psi (1.0 bar)
on cold start ..... 45 psi (3 bar)
(Valid for speed range Nmin. to Nmax.)

A charge flow filter with bypass and with clogging indicator is recommended. FILTER ELEMENT MUST BE CAPABLE OF WITHSTANDING FULL CHARGE PRESSURE WITHOUT COLLAPSING.

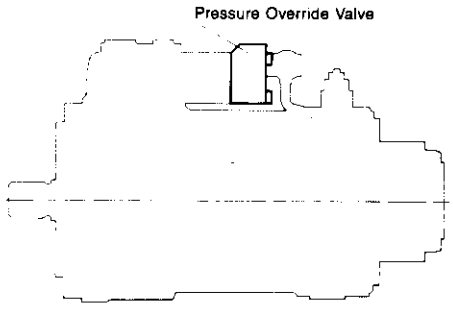
***NOTE:** Ordering code option 2 is not available on pumps fitted with the Speed Sensing Horsepower Limiter. If option 2 is required along with horsepower limiting, an external limiting valve is needed. Contact Rexroth for details.

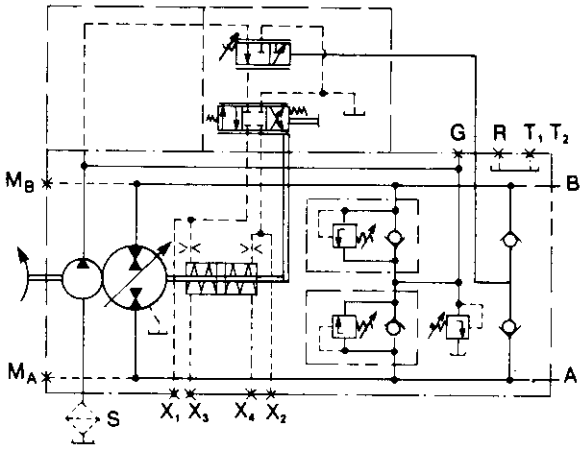
Ordering Code Option Number 5
Filter in charge pressure loop of AA4V. Filter direct mounted to AA4V pump.

Contact Rexroth for details and availability of this option.

PRESSURE OVERRIDE

With porting for a pressure override valve (P.O.R.). The pressure override valve varies the swashplate angle as required to limit the maximum pressure of port A or B. The override valve prevents continuous dumping of excessive flow at load pressure through the cross port relief valves contained in the pump. This eliminates unnecessary heating of the oil and protects the pump and motor from heavy-handed operators, or if the drive stalls causing the pump to deadhead. The pressure override valve should be adjusted to a pressure 500 psi (34 bar) less than the setting of the main relief valves and have an adjustment range of 1160-6100 psi (80-420 bar).





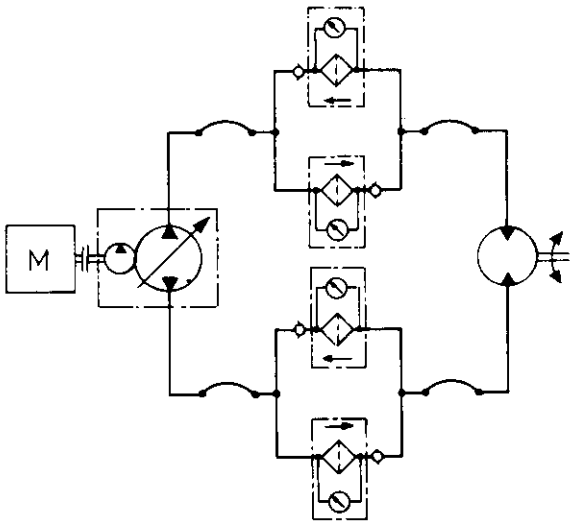
Variable pump AA4V with hydraulic manual servo control, HW with pressure override valve (P.O.R.)

Pre-Start & Start-Up Procedure

Pre-Start Procedure

This should be performed prior to start-up of a new installation, or for a system in which new or overhauled components have been fitted.

1. Ensure that hydraulic reservoir piping and pressure hoses are cleaned and flushed.
2. Fill the reservoir through fill pump and filter.
3. If there is any doubt regarding the absolute cleanliness of the system, fit high pressure bi-direction filters in high pressure lines as shown in following diagram. These filters are in addition to the installed suction and return filters.



4. Check that all filters have elements of the correct rating and the filter housings are filled with the hydraulic fluid to be used in the system.
5. Where possible, fill the high pressure lines.
6. Open suction line valves.
7. Fill pump and motor cases to the highest case drain or vent port (marked T or R).
8. Check that all pressure connections are secure.
9. Ensure all mechanical gearboxes have the correct oil type and are filled to the prescribed level.
10. Fully back off all high pressure relief valves and then reset one half turn against the spring.
11. Fully back off the charge and pilot pressure relief valves, and reset two full turns against the spring.
12. Fit 10,000 psi pressure gauges to each high pressure line.
13. Fit 500 psi pressure gauges to charge and pilot circuits (ports M_1, X_3, X_4, Y_1, Y_2).
14. Fit 100 psi pressure gauge to pump case drain port R.
15. Fit vacuum gauge to the charge pump suction line as close as possible to suction port.
16. Release brakes and jack up the driving wheels. Winches should be started without the cable fitted.
17. Ensure that the fluid temperature in the reservoir is 45°F. or higher.

Start-Up Procedure

The following procedure has been developed based on experience with most types of applications, however, certain applications may require a departure from, or variations to, this procedure.

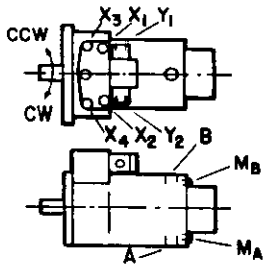
For the start-up of new or overhauled installations.

1. If the prime mover is:
   Internal combustion engine: (diesel, gasoline or LP)—Remove the coil wire, close the injector rack or leave the gas turned off and turn the engine over until the charge pressure reaches 50 psi or more.
   Electric Motor: Jog the starting circuit until the charge pressure reaches 50 psi or more.
2. Start the prime mover and if possible, maintain a pump speed of approximately 750 rpm for 5 minutes. This will allow the system to be filled.
3. Listen for any abnormal noises.
4. Check for oil leaks.
5. Run prime mover to 1800 rpm. (Adjust to the design speed if less than 1800 rpm.)
6. Set charge and pilot pressure as required for the application. (Refer to circuit schematic)
7. For the HD control, bleed the pilot lines by loosening the connections at Y_1 and Y_2 and then actuate the remote control unit in both directions until oil seeps from the connections.
8. Retighten all connections.
9. Operate control to work the hydrostatic transmission at approximately 20% of maximum speed.
10. Deaerate system by venting a bleed valve or by cracking the highest connection until fluid seeps out without bubbles.
11. Check fluid level and add fluid if necessary.
12. Continue operating transmission and gradually increase to full speed, still with no load.
13. With controls neutralized, check for creep in neutral. If evident, center the control in accordance with the instructions on Pages 17 and 18.
14. Check that the controls are connected so that the transmission operates in the correct direction related to the control input.
15. Continue to monitor all pressure gauges and correct any irregularities.
16. Apply brakes and set high pressure relief valves (and pressure override if installed) to levels required for the application by stroking the pump to approximately 20% of maximum displacement. See Pages 19 and 20.
17. Check security of high pressure connections.
18. Check oil level and temperature.
19. Remove and inspect high pressure filter elements. Replace with new elements.
20. Operate transmission under no-load conditions for about 15 minutes to stabilize the temperature and remove any residual air from the fluid.
21. Again remove and inspect high pressure filter elements. If clean, the high pressure, bi-direction filters may be removed from the circuit. If contamination is still evident, fit new elements and continue flushing until the system is clean.
22. Replace the elements in the charge pump suction or pressure filter, whichever is installed.
23. Operate the transmission under full and normal load conditions.
24. Erratic operation may indicate there is still air trapped in the system. By working the pump control to one or both sides the remaining air can be eliminated. The system is free of air when all functions can be operated smoothly and when there is no foam on the surface of the oil in the reservoir (usually less than 1 hour of operation).

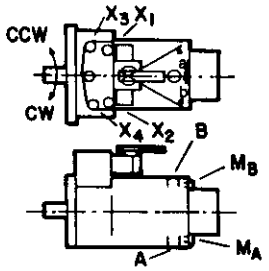
NOTE: If after following the Pre-Start and Start-Up procedures the transmission does not perform correctly, refer to the relevant sections of the troubleshooting procedures on Pages 14, 15, and 16.

Diagnostic Ports

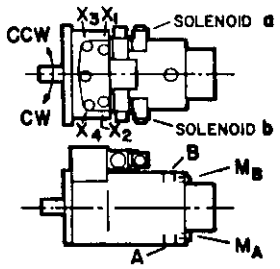
HD Control				
DIRECTION OF ROTATION	CLOCKWISE		COUNTERCLOCKWISE	
PILOT PRESSURE AT	Y_1	Y_2	Y_1	Y_2
POSITIONING PRESSURE AT	X_1, X_3	X_2, X_4	X_1, X_3	X_2, X_4
OUTPUT FLOW FROM PORT	B	A	A	B
WORKING PRESSURE AT	M_B	M_A	M_A	M_B



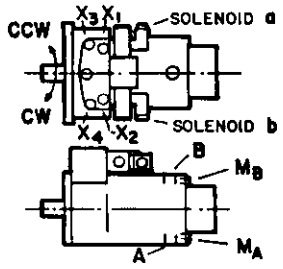
HW Control				
DIRECTION OF ROTATION	CLOCKWISE		COUNTERCLOCKWISE	
LEVER MOVEMENT DIRECTION	a	b	a	b
POSITIONING PRESSURE AT	X_2, X_4	X_1, X_3	X_2, X_4	X_1, X_3
OUTPUT FLOW FROM PORT	A	B	B	A
WORKING PRESSURE AT	M_A	M_B	M_B	M_A



EL Control				
DIRECTION OF ROTATION	CLOCKWISE		COUNTERCLOCKWISE	
SOLENOID OPERATION	a	b	a	b
POSITIONING PRESSURE AT	X_1, X_3	X_2, X_4	X_1, X_3	X_2, X_4
OUTPUT FLOW FROM PORT	B	A	A	B
WORKING PRESSURE AT	M_B	M_A	M_A	M_B



DA or EL/NP Control				
DIRECTION OF ROTATION	CLOCKWISE		COUNTERCLOCKWISE	
SOLENOID OPERATION	a	b	a	b
POSITIONING PRESSURE AT	X_2, X_4	X_1, X_3	X_2, X_4	X_1, X_3
OUTPUT FLOW FROM PORT	A	B	B	A
WORKING PRESSURE AT	M_A	M_B	M_B	M_A



HM Control				
DIRECTION OF ROTATION	CLOCKWISE		COUNTERCLOCKWISE	
PILOT PRESSURE AT	Y_1	Y_2	Y_1	Y_2
POSITIONING PRESSURE AT	X_1, X_3	X_2, X_4	X_1, X_3	X_2, X_4
OUTPUT FLOW FROM PORT	B	A	A	B
WORKING PRESSURE AT	M_B	M_A	M_A	M_B

NOTE: Pressure gauge connections should be located as close as possible to the pump port being gauged.

Port Designations Pressure Limits

PORT	PRESSURE LIMITS
R Case Vent	30 psig
X_1 (X_3) Control Pressure	580 psig
X_2 (X_4) Control Pressure	580 psig
G Charge Pump Access Port	580 psig
S Charge Pump Suction Port	14 in. Hg (at start-up)
M_A High Pressure at A	6000 psig
M_B High Pressure at B	6000 psig

Diagnostic Ports

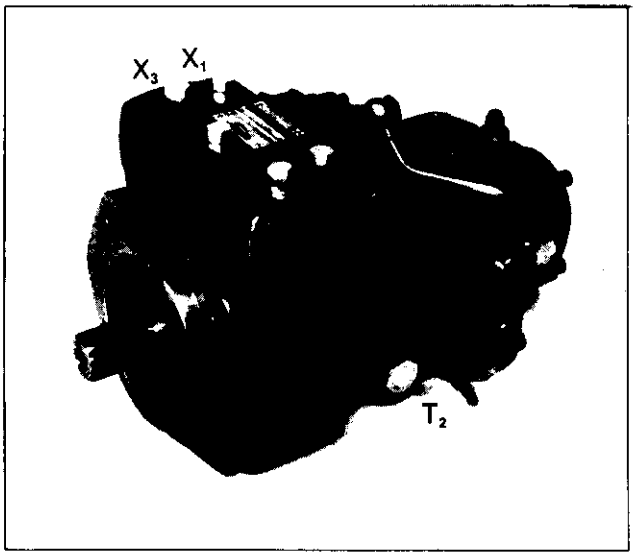
R —Case vent port
All sizes 7/16"-20 UNF

X_1, X_2 —Control pressure gauge port (before control orifices). All sizes 7/16"-20 UNF

X_3, X_4 —Control pressure gauge ports (after control orifices). All sizes 7/16"-20 UNF

T_1, T_2 —Case drain ports
Sizes 40, 56 7/8"-14 UNF
Size 90 1 1/16"-12 UNF
Size 125 1 5/16"-12 UNF

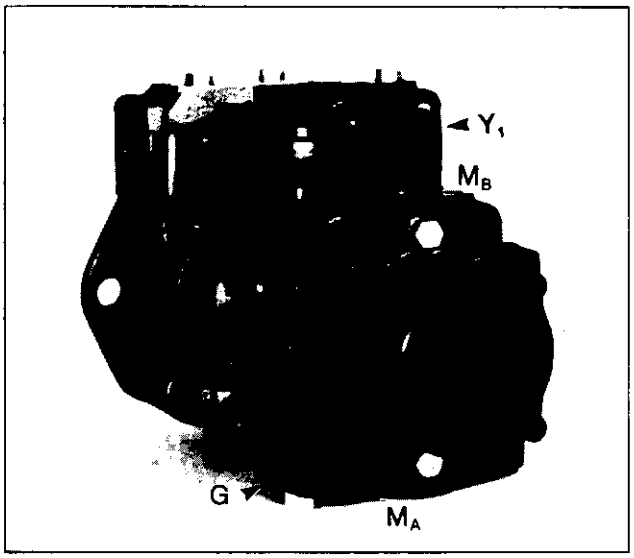
A, B —Service ports
Sizes 40, 56 SAE 3/4" - 6000 psi
Size 90 SAE 1" - 6000 psi
Size 125 SAE 1 1/4" - 6000 psi



M_A, M_B—High pressure gauge ports
All sizes 7/16"-20 UNF

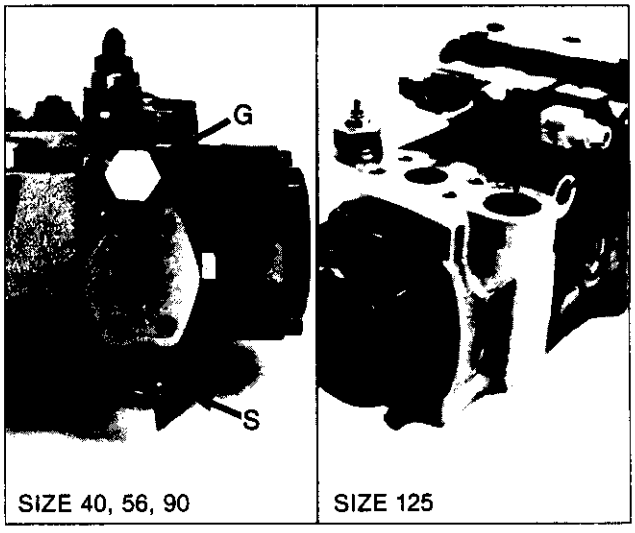
Y_1, Y_2 —Remote hydraulic pilot control ports (HD and HM control only.) All sizes 9/16"-18 UNF

A_1, B_1 —Auxiliary service ports
All sizes 3/4"-16 UNF



G —Charge pump access port
Sizes 40, 56 7/8"-14 UNF
Sizes 90, 125 1 1/16"-12 UNF

S —Charge pump suction port
Sizes 40, 56 7/8"-14 UNF
Sizes 90 1 3/16"-12 UNF
Sizes 125 1 5/8"-12 UNF



SIZE 40, 56, 90 SIZE 125

To aid in troubleshooting, refer to the diagnostic port connections for test gauge installation information. Procedure assumes gauges are installed.

This procedure was written to aid the troubleshooter in following a logical approach to a system fault.

1. TRANSMISSION DOES NOT DRIVE WITH THE PRIME MOVER RUNNING.

1.1 Is there oil in the reservoir?	No Fill reservoir. Yes Proceed to step 1.2.
1.2 Is engine clutch engaged?	No Engage clutch. Yes Proceed to step 1.3.
1.3 Is the hydraulic piping in accordance with the hydraulic circuit?	No Correct the piping. Yes Proceed to step 1.4.
1.4 Is the pump direction of rotation correct?	No Fit pump having the correct direction of rotation. Yes Proceed to step 1.5.
1.5 Is there a broken pipe, loose fitting, or burst hose?	No Proceed to step 1.6. Yes Repair the fault.
1.6 Are the brakes released?	No Check brake release circuit or mechanism. Yes Proceed to step 1.7.

Charge Pump and Relief Valve:

1.7 Is there any charge pressure at port G?	No Proceed to step 1.10. Yes Proceed to step 1.8.
1.8 Is the charge pressure at specification while the pump is running at normal operating speed?	No Proceed to step 1.9. Yes Proceed to step 1.19.
1.9 Can the charge pressure be adjusted at the charge pressure relief valve? (Refer to relief valve adjustment.)	No Proceed to step 1.10. Yes Adjust charge pressure to specification and proceed to step 1.19.

Note: If flushing valve is used in circuit, it should be set at 50 psi less than charge pump relief. Refer to data sheet on flushing valve for information and setting procedure.

1.10 Is suction line shut-off valve open?	No Open valve. Yes Proceed to step 1.11.
1.11 Is the charge pump suction pressure within recommended limits? (−3.2 psig or 6.5 in. Hg vacuum.)	No Proceed to step 1.12. Yes Proceed to step 1.16.
1.12 Is suction filter element plugged?	No Proceed to step 1.13 Yes Replace filter element.
1.13 Does the reservoir design ensure that suction pipe is always covered with oil?	No Correct the reservoir design. Yes Proceed to step 1.14.
1.14 Is the suction pipe size adequate for the flow?	No Run at lower speed and return to point 1.7, or rework suction piping. Yes Proceed to step 1.15.
1.15 Is the reservoir air breather blocked or undersized?	No Proceed to step 1.16. Yes Clean or replace air breather.
1.16 Remove charge pressure relief valve cartridge and inspect. Is it damaged?	No Refit cartridge and proceed to step 1.17. Yes Fit a new cartridge and return to step 1.7.
1.17 Remove and inspect charge pump assembly. Is it damaged?	No Proceed to step 1.18. Yes Repair or replace damaged components and return to step 1.7. Note: replace charge pump as complete unit.
1.18 Is the charge pump installed for correct direction of rotation?	No Refit charge pump by rotating pump housing 180°. Return to step 1.7. Yes With proper charge pressure, and transmission still does not operate, proceed to step 1.19.

Pump Control:

1.19 Is control medium connected to pump control? HD—pilot pressure HW—mechanical cable or linkage EL 12 or 24 volts dc electrical current	No Connect appropriate medium and check that control signal is actually being applied to the control valve. Yes Proceed to step 1.20.
1.20 If variable displacement motors are installed, is maximum displacement selected? (if not done automatically).	No Select maximum displacement. Yes Proceed to step 1.21.
1.21 Actuate the control in both directions. Does pump stroke?	No Proceed to step 1.22. Yes Operate the transmission.
1.22 Stroke the pump in both directions. Do the pressures at X_3 and X_4 alternate between 30 and 250 psi during cycle?	No Remove control module and replace with new unit. Repeat step 1.21. Yes Proceed to step 1.23.
1.23 Is the pressure at port R less than 21 psi?	No Repipe pump case drain line so that case pressure at port R is less than 21 psi. Return to step 1.21. Yes Proceed to step 1.24.
1.24 Stroke pump in both directions. Does any pressure greater than 350 psi alternate between ports M_A and M_B?	No Verify that loading of the pump will cause system pressure to increase above charge pressure. Proceed to step 1.19. Yes Proceed to step 1.25.
1.25 Is it possible to adjust high pressure relief valves using the 0-10,000 psi gauges at M_A and M_B to monitor pressure? (Refer to relief valve adjustment.)	No Replace high pressure relief valve cartridges and return to step 1.21. Yes Adjust high pressure relief valves to required or design pressure. Proceed to step 1.26.
1.26 Actuate control in both directions. Does transmission run?	No Check if motor sizing is adequate for application. Check for mechanical faults in the drive beyond the motor shaft. Yes Operate the transmission.

2. TRANSMISSION DRIVE IS SLUGGISH OR ERRATIC

2.1	Is the control medium in good condition? For example: control medium is not in good condition if: HD control—air in pilot lines HW control—sticking cable or linkage EL control—fluctuating control current.	No Rectify the control fault. HD—bleed pilot lines HW—lubricate or free the cable or linkage EL—check control current Yes Proceed to step 2.2
2.2	Are the brakes fully released?	No Check brake release circuit or mechanism. Yes Proceed to step 2.3.
2.3	Are the stroking time orifices correctly sized for the application?	No Remove the plugs in ports X_1 and X_2 and remove control orifices wtih screwdriver. Try various sizes until desired pump stroking rate is attained. Yes Proceed to step 2.4.
2.4	With HD control, is the control curve of remote pilot valve correctly matched to the pump?	No Change spring to suit. AA4V pump—curve 05 or 06 of 4TH7 pilot operator. Yes Proceed to step 2.5.
2.5	Does the charge pressure fluctuate more than 30 psi when stroking the pump?	No Proceed to 2.9. Yes Proceed to step 2.6.
2.6	If the charge pump output is used to operate auxiliary functions, do these other functions cause fluctuations in charge pressure?	No Proceed to step 2.8. Yes Proceed to step 2.7.
2.7	Isolate the auxiliary function and run the transmission. Are the charge pressure fluctuations reduced or eliminated?	No Proceed to step 2.8. Yes Operate transmission and return to step 2.1.
2.8	Are there system pressure fluctuations which are synchronous with the charge pressure fluctuations?	No Proceed to step 2.9. Yes Determine the cause of system pressure fluctuations.
2.9	If variable displacement motor is used, is motor stroking time correct for the application?	No Add motor stroking time adjustment valve to the variable motor or modify the control circuit to provide desired stroking time.

3. TRANSMISSION DRIVES IN ONE DIRECTION ONLY

3.1	With control lines switched, does pump drive in the opposite direction only?	No Proceed to step 3.2. Yes Control signal from one side does not work properly. Repair as necessary.
3.2	With control lines still switched, does pump drive in initial direction only?	No Proceed to step 3.3. Yes Problem is in one side of control module or the pump. Proceed to step 3.3.
3.3	Is there control pressure or current from both control lines?	No Correct control signal problem. Yes Proceed to step 3.4.
3.4	Check flushing valve (if installed). Is shuttle spool stuck in one position?	No (Not installed.) Proceed to step 3.5. Yes Remove flushing valve and clean or replace.
3.5	Switch relief valves. Does transmission drive in the other direction only?	No Proceed to step 3.6. Yes Repair or replace relief valve on non-driving side.
3.6	Replace control module and reconnect control lines. Does pump operate properly?	No Replace or repair pump. Yes Operate transmission

4. TRANSMISSION DRIVES IN THE WRONG DIRECTION

4.1	Pump with HD control.	Switch control lines on ports Y_1 & Y_2.
4.2	Pump with EL control.	Switch electrical connectors on solenoids A & B.
4.3	Pump with HW control.	Rework linkage or cable to give correct drive direction.

5. PUMP DOES NOT FIND OR HOLD NEUTRAL (Also refer to Pages 16 and 17.)

5.1	Does pump return to neutral with control lines removed?	No Proceed to step 5.2. Yes Check control for electrical signal problem (EL control), or back pressure in the pilot lines (HD control).
5.2	Check mechanical centering of pump and control per Pages 16 and 17. Does pump return to neutral with control lines removed?	No Repair or replace pump. Yes Replace control module if needed. Operate transmission.

6. TRANSMISSION DRIVES AT A HIGH NOISE LEVEL

6.1 Are the drive gearboxes filled with correct grade of oil?
- No Fill gearbox with correct grade of oil to the prescribed level.
- Yes Proceed to step 6.2.

6.2 Is the drive coupling correctly installed and aligned?
- No Install coupling per manufacturer's instructions and tolerances.
- Yes Proceed to step 6.3.

6.3 Is rigid piping connected to the pump?
- No Proceed to step 6.4.
- Yes Install short length of hose between pressure ports of the pump and the system piping.

6.4 Is the suction pressure at the charge pump inlet within recommended limits?
- No Return to step 1.7.
- Yes Proceed to step 6.5.

6.5 Is there air in the hydraulic oil? This may be indicated by foaming or milky colored oil.
- No Proceed to step 6.6.
- Yes Deaerate the oil and inspect system for cause of air induction.

6.6 Is the hydraulic motor operating at excessive speed?
- Yes Check motor sizing in relation to available oil flow from the pump.

7. TRANSMISSION OPERATES AT A HIGHER THAN NORMAL TEMPERATURE

7.1 Is the operating temperature above 195°F?
- No 195°F is the upper limit. If temp. is close to 195°F, the oil cooler may need to be cleaned.
- Yes Proceed to step 7.2.

7.2 Is the hydraulic motor stalling intermittently?
- No Proceed to 7.3.
- Yes Hydraulic oil is being heated through system relief valves. Shut down system and rectify cause of the motor stall.

7.3 Does temperature remain above 195°F after cleaning oil cooler?
- No Operate transmission. Check oil cooler more often.
- Yes Proceed to step 7.4.

7.4 Check differential pressure across oil cooler as compared to the manufacturer's specs at charge pump flow.

Is $\triangle$ P higher than it should be?
- No Proceed to step 7.5.
- Yes Check piping from oil cooler to the reservoir.

Check for plugged or damaged cooler.

NOTE: Max. case pressure is 30 psi.

7.5 Disconnect pump case drain from oil cooler and check flow from charge pump. Is flow normal?
- No Refer to charge pump remove and inspection procedure.
- Yes Check oil cooler location.

8. PUMP DOES NOT DEVELOP MAXIMUM HORSEPOWER (FLOW & PRESSURE)

8.1 Does the charge pressure meet specifications as measured at port G?
- No Return to 1.9.
- Yes Proceed to 8.2.

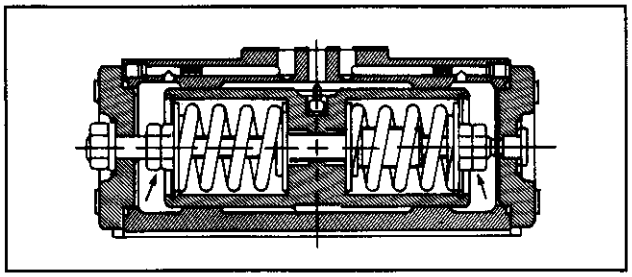
8.2 Is the case pressure less than 30 psi?
- No Check sizing of return lines from T port of pump and the cooler sizing related to flow.
- Yes Proceed to 8.3.

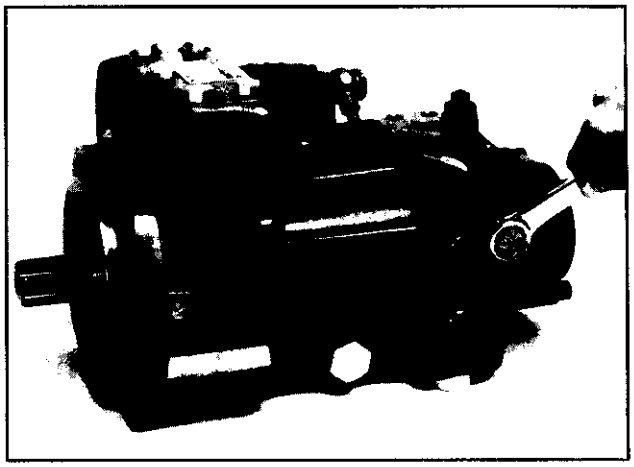
8.3 Are the high pressure relief valves adjusted to the required pressure so that they do not by-pass?
- No Adjust or replace relief valve cartridge.
- Yes Replace the pump.

NOTE: If pressure override valve is fitted to pump, check that pressure setting is sufficient for the application.

Mechanical Centering of Pump

The control piston has strong centering springs to ensure that once the pump is adjusted for neutral position it will always return to neutral. If an adjustment is necessary follow the steps listed below.



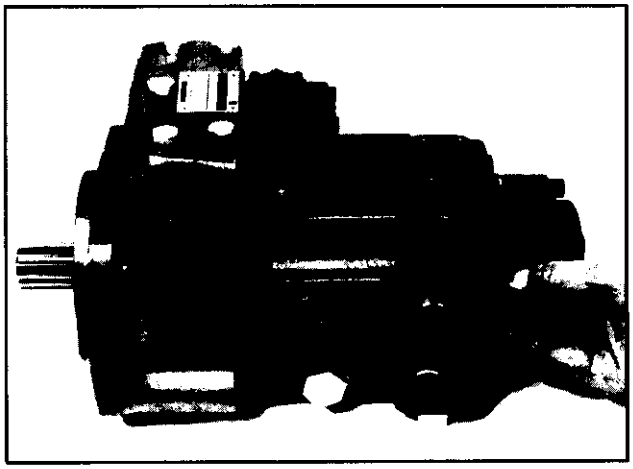


To ensure there will be no control pressure at the control module during the centering operation, remove the piping assembly. All sizes require 19mm box wrench.

Plug the control pressure outlet port before running the pump. Block pump ports A & B, or install a hydraulic motor.

NOTE:
The control pressure outlet port has an M14×1.5 thread. Use a M14×1.5 plug (Part Nbr 76116-001), or combination of M14×1.5 to 9/16—18UNF adapter (Part Nbr 5974-101-002) and 9/16—18UNF plug, to plug this port during the mechanical centering operation.

Alternate method to neutralize control: Instead of removing control pipe, connect ports X_3 & X_4 by means or a low pressure hose.

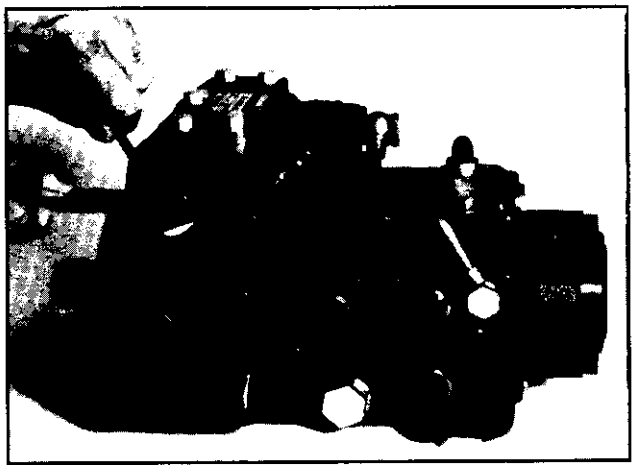


With pressure gauges installed at M_A and M_B as per Page 12, and with the pump running, loosen the jam nut and turn the adjusting screw until equal pressure (charge pressure) is registered on the two gauges. Alternatively, if a hydraulic motor is connected to the pump, turn the adjusting screw until the motor shaft does not rotate.

Tighten the jam nut, stop the pump drive, remove the plug in the control pressure port, open ports A & B, and reinstall the control pressure pipe.

Alternate method: Remove the low pressure hose connecting ports X_3 & X_4 and plug ports X_3 & X_4.

Pump Size	Allen Wrench	Wrench
40	5mm	17mm
56	5mm	17mm
90	6mm	19mm
125	6mm	22mm



Hydraulic Centering of Control Modules HD, HW, EL

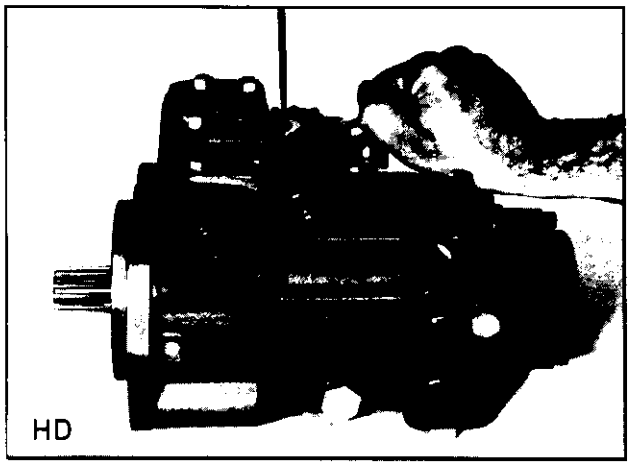
When control modules are exchanged or replaced, it is generally necessary to center the new module. This is done by running the pump with gauges installed at ports X_3 and X_4, and M_A and M_B as shown on Page 12. Then release the jam nut and turn the adjustment screw on top of the control module valve body.

NOTE:
The adjustment screw is eccentric, therefore, turning more than 90° in either direction will have no further centering effect and may cause the control to bind. FOR ALL PUMP SIZES, A SMALL SCREWDRIVER AND 10mm WRENCH ARE REQUIRED TO PERFORM THIS ADJUSTMENT.

Centering the HD Control Module

With zero pilot pressure at both pilot ports Y_1 and Y_2, neutral position of the HD control is correctly adjusted when any or all of the following conditions exist:

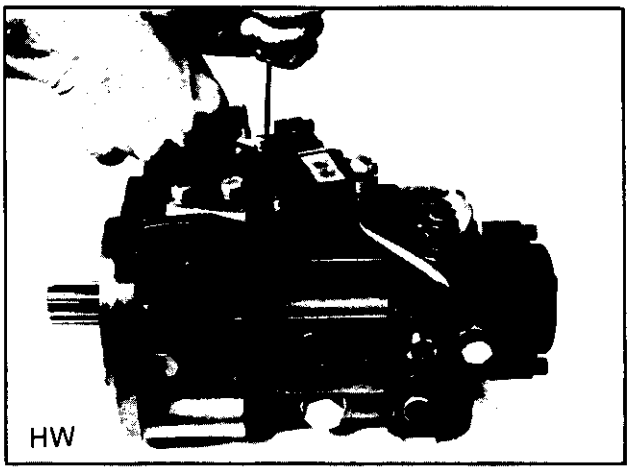
1. The hydraulic motor does not turn when the brake is released.
2. Charge pressure is registerd equally at ports M_A and M_B when flow output of the pump is deadheaded against a locked motor or a valve.
3. Approximately equal control pressures are obtained at control pressure ports X_3 and X_4.



Centering the HW Control Module

With the control lever allowed to freely spring to its center position, the HW control module is correctly adjusted when any or all of the following conditions exist:

1. The hydraulic motor does not turn when the brake is released.
2. Charge pressure is registered equally at ports M_A and M_B when flow output of the pump is deadheaded against a locked motor or a valve.
3. Approximately equal control pressures are obtained at control pressure ports X_3 and X_4.

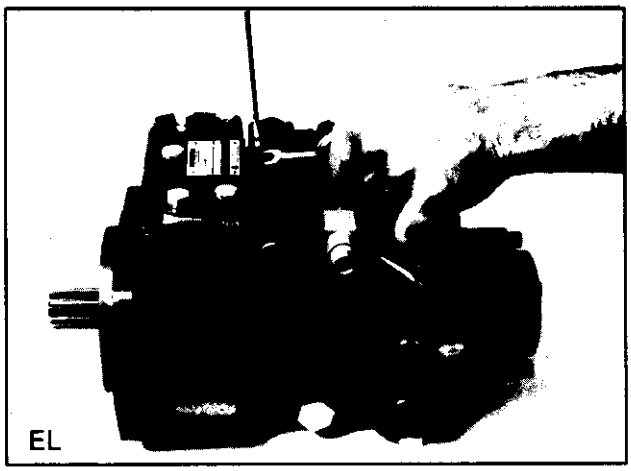


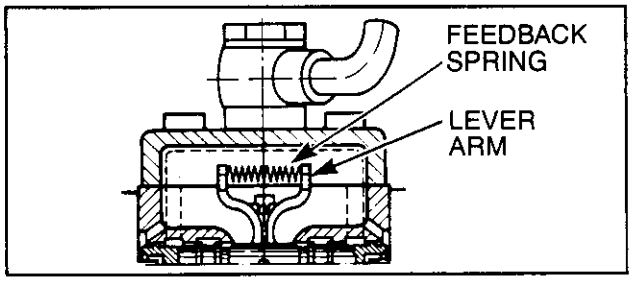
Centering the EL Control Module

With no electrical signal to solenoids A and B (remove both plug-in connectors), the EL control module is correctly adjusted when any or all of the following conditions exist:

1. The hydraulic motor does not turn when the brake is released.
2. Charge pressure is registered equally at ports M_A and M_B when flow output of the pump is deadheaded against a locked motor or a valve.
3. Approximately equal control pressures are obtained at control pressure ports X_3 and X_4.

If difficulties are encountered in obtaining neutral position of the HD or EL control modules, check that the ends of the control spring are correctly located in the grooves near the end of the feedback lever arms.

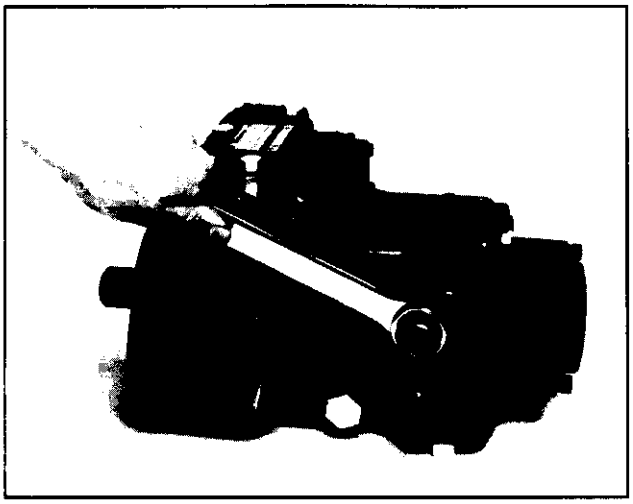




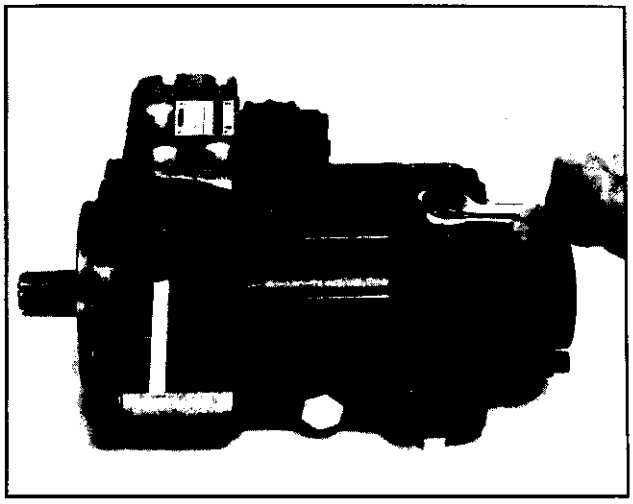
REXROTH
WORLDWIDE HYDRAULICS

Removal and Adjustment of Relief Valves

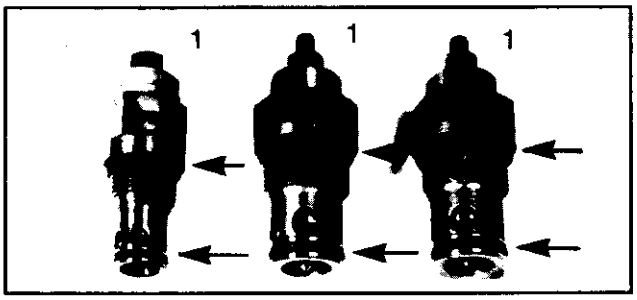
Pump Size	System Relief		Charge Relief Wrench Size
	Wrench Size	Assembly Torque	
40	27mm	100 Ft.-lb.	22mm
56	27mm	100 Ft.-lb.	22mm
90	36mm	125 Ft.-lb.	27mm
125	30mm	180 Ft.-lb.	36mm



Removal of combination high pressure relief/makeup check valve cartridge.



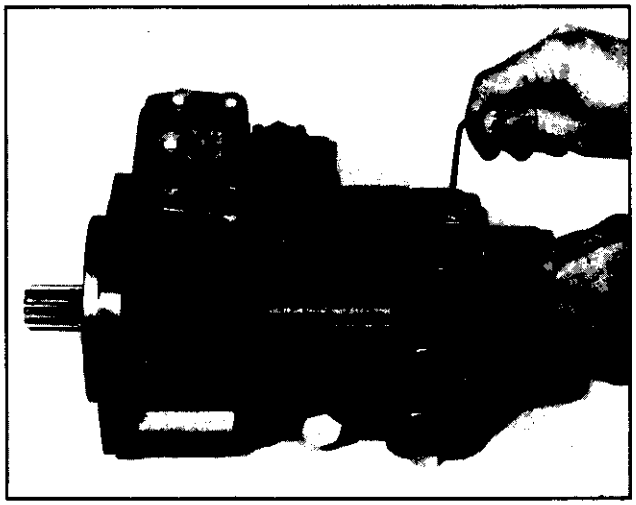
Removal of charge pressure relief valve.



Inspect valves and seals for wear or damage. Replace seal-lock nut (1) and O-rings if there are signs of wear or damage. Seal-lock nuts are included in the seal kit.

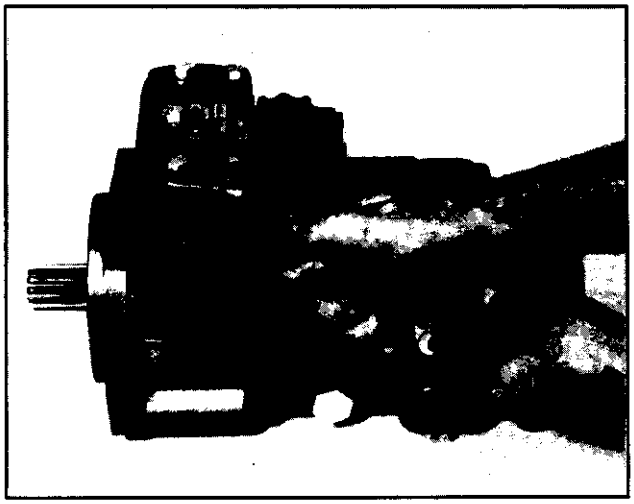
NOTE:
Certain relief valves have limited adjustment ranges. Refer to the ordering code on Page 4 for the relief valve pressure range of your pump.

All relief valve adjustments to be done with 3mm allen wrench and 10mm box wrench, except for new design size 90 system reliefs which use a 5mm allen wrench and a 17mm box wrench.



Adjustment of charge pressure relief valve. Pressure gauge at port G as shown on Page 12. Run pump at normal operating speed in neutral and adjust pressure to specification.

NOTE: If pump is equipped with P.O.R. (Pressure Override) valve, see Page 19 for proper adjustment procedure.



Adjustment of high pressure relief valves. Pressure gauges at ports M_A and M_B as shown on Page 12. Run the pump at normal operating speed. Stroke the pump to approx. 20% of maximum displacement and adjust pressure as required.

NOTE: Flow must not spill over high pressure relief valves for more than 10 seconds.

Adjustment of Pressure Override Valve

Function of Pressure Override

The pressure override valve varies the swashplate angle, as required, to limit the maximum pressure at port A or B. The override valve prevents continuous dumping of excessive flow at load pressure through the cross port relief valves contained in the pump. This eliminates unnecessary heating of the oil and protects the pump and motor from heavy-handed operators or, if the drive stalls causing the pump to deadhead. The pressure override valve should be adjusted to a pressure 500 psi less than the setting of the main relief valves.

Adjustment Procedure

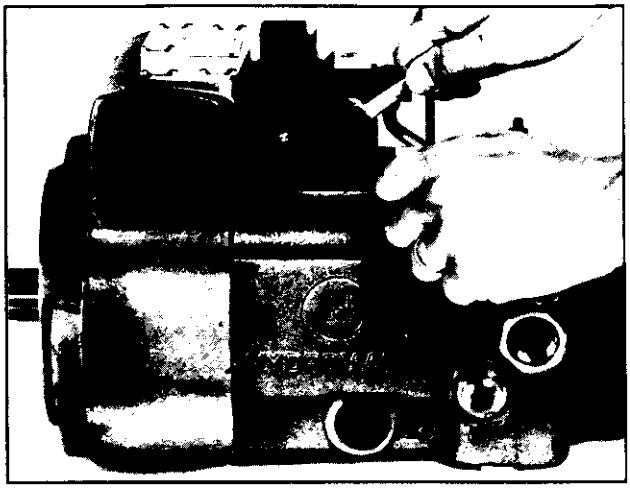
Following is a suggested procedure for adjusting the P.O.R. It is assumed that high pressure gauges are connected to ports M_A and M_B as shown on Page 12. Some applications may require a slight departure from the procedure.

1. Block the output flow from the high pressure ports A & B, or lock the hydraulic motor by applying the brake.
2. Using a 3mm allen wrench, turn both high pressure relief valve adjusting screws counterclockwise until the spring tension is completely relieved, then turn both adjusting screws one full turn clockwise.
3. Turn the P.O.R. adjusting screw in (clockwise) until firm resistance is encountered. Do not force the adjustment beyond this point.
4. Stroke the pump to approximately 20 percent of full flow in one direction and adjust the high pressure relief valve for that flow direction to a pressure which is 500 psi higher than the required P.O.R. pressure setting.
5. Repeat step 4 for the opposite direction of flow.

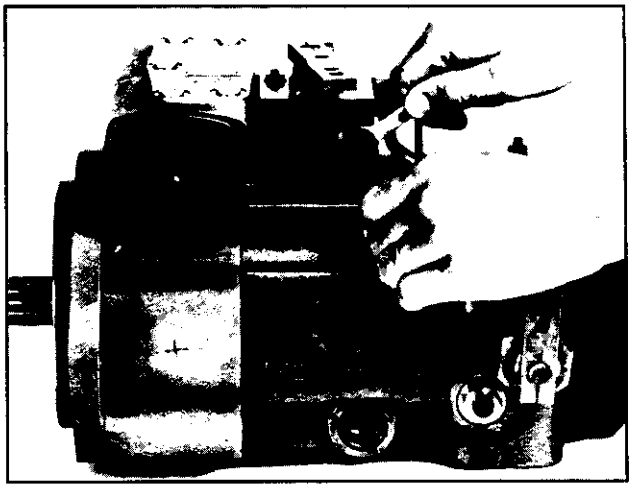
NOTE:
Perform steps 4 & 5 as quickly as possible to prevent overheating of the pump. Flow must not be permitted to spill over the high pressure relief valves for longer than 10 seconds, especially at higher pressures.

6. Neutralize the pump control and turn P.O.R. adjusting screw counterclockwise, all the way out.
7. Stroke the pump fully in either direction, then turn the P.O.R. adjusting screw in (clockwise) until the desired pressure setting is achieved.
8. Stroke the pump for opposite flow direction to that used in step 7 and check the operation of the P.O.R. Equal maximum pressures should be seen both sides of center.

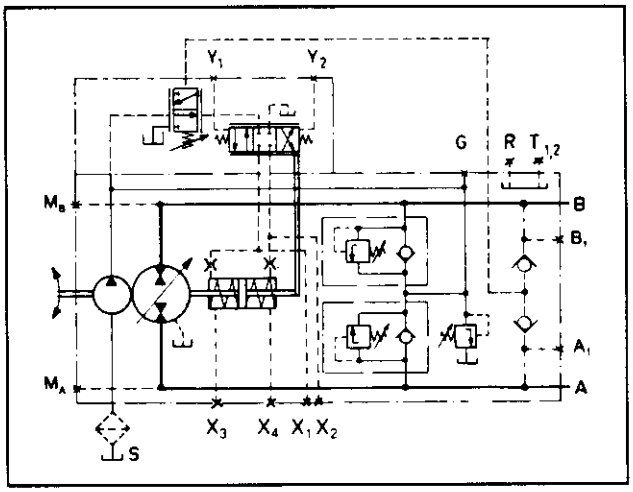
NOTE: All adjustments require a 3mm allen wrench and 10mm box wrench except for new design size 90 system reliefs which use a 5mm allen wrench and 17mm box wrench



Adjustment of P.O.R. valve on pumps with remote hydraulic pilot control, type HD, and proportional electric control, type EL. (Illustrated).

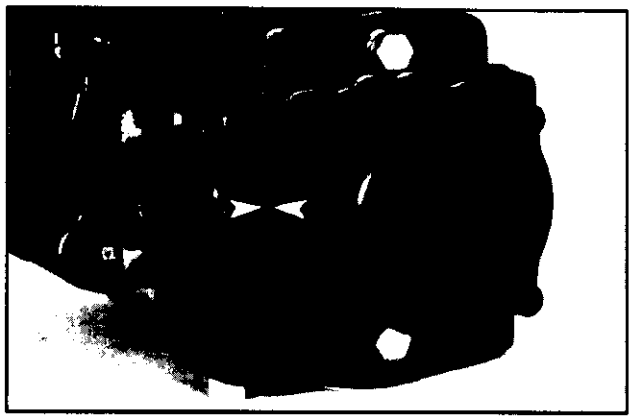


Adjustment of integral P.O.R. valve on pumps fitted with rotary manual servo control, type HW.



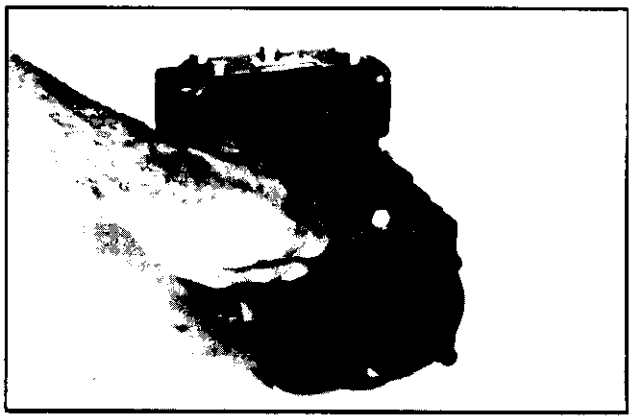
Circuit schematic of AA4V hydrostatic transmission pump with P.O.R. HD control is shown. Other control types use same P.O.R. schematic.

Removal and Inspection of Charge Pump



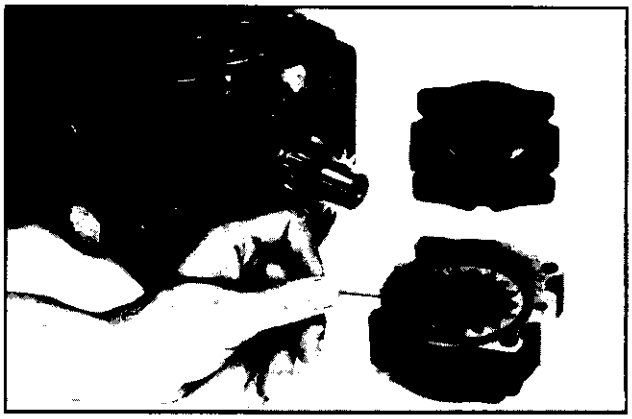
Before removing cap screws, mark the position of the charge pump housing and separator plate in relation to the port block.

NOTE:
Charge pumps are the same for right and left hand rotation pumps. However, charge pump must be mounted with correct orientation or charge pump will not supply oil into closed loop.



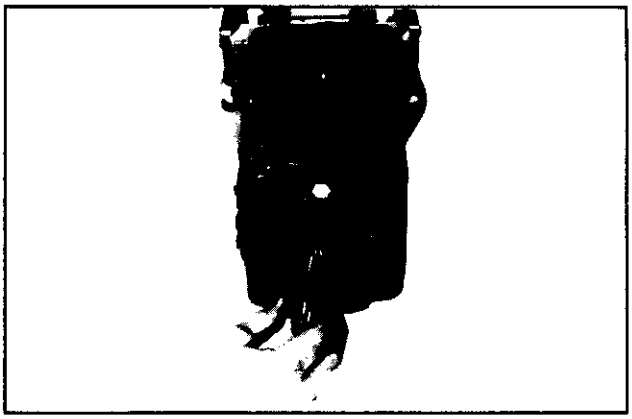
Loosen screws with metric allen wrench.

Pump Size	Wrench Size
40	6mm allen
56	6mm allen
90	6mm allen
125	8mm allen



Remove charge pump housing and inspect for wear or damage to gear set and O-ring seal. Grease O-ring prior to reassembly.

Be sure O-ring is completely seated in groove.



Withdraw pinion shaft and inspect gear teeth and bearing surfaces for abnormal wear.

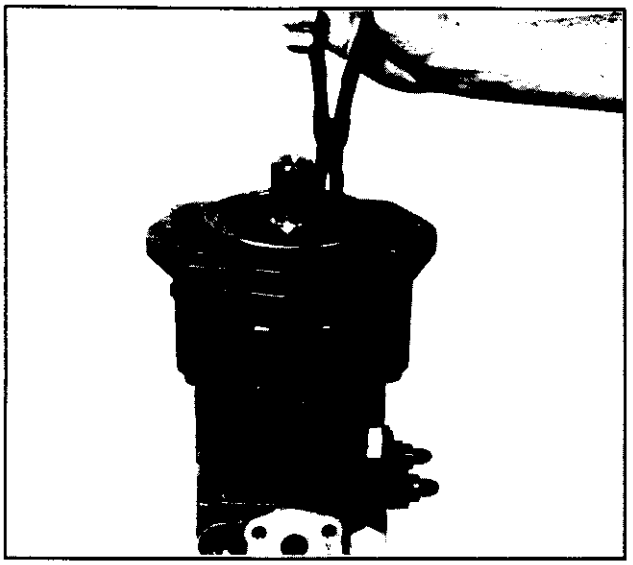
When reassembling, make sure chamfer (on outer edge of driven gear) goes down into charge pump housing.

Torque values for bolts when replacing charge pump.

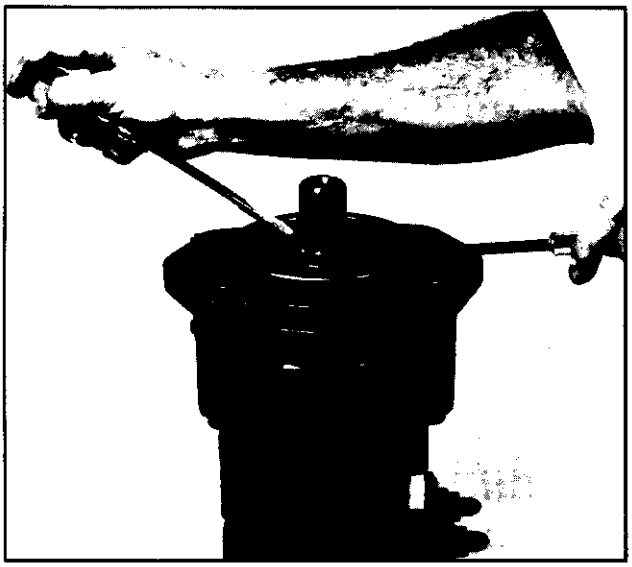
Pump Size	Torque (in-lb)
40	220
56	220
90	220
125	440

NOTE:
If serious wear or damge has occured to one component, the complete charge pump assembly must be replaced because they are matched components.

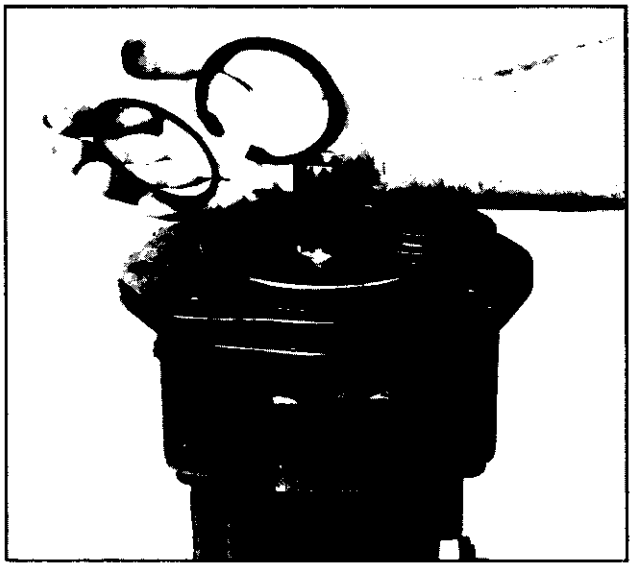
Replacement of Shaft Seal



Remove the retaining ring with snap ring pliers.



With two screw drivers, carefully pry up on shaft seal housing to remove.



Replace O-ring and radial seal. Lubricate parts before assembly.

Re-install retaining ring.

NOTE:
On the size 125 pump, use care when replacing the shaft seal. The O.D. of the pump drive shaft is approximately the same diameter as the seal I.D., and therefore, the seal could be damaged when sliding over the spline surfaces.

Routine Maintenance

The AA4V variable pumps are relatively maintenance free. Maintenance work is confined to the system by way of oil changes and renewal of filter elements. Both of these measures promote system cleanliness. Monitoring and periodic maintenance of the system can prevent premature breakdowns and repairs. Under normal application conditions, the following maintenance intervals are suggested:

1. Renewal of Filter Elements

a. After commissioning
b. After 500 operating hours
c. Thereafter during an oil change
d. With suction filtration, the filter element should be renewed as soon as a charge pump inlet pressure of less than −3.2 psig (0.8 bar absolute) becomes evident with the transmission in warm running condition (indicates contiamination).
e. With charge flow filtration, watch for high pressure differential across the filter element. (Refer to filter manufacturer's specifications)

Caution: Only filter elements capable of meeting or exceeding the fluid cleanliness level requirement (ref. p. 9) should be used.
Note: Paper inserts cannot be cleaned; use throw-away cartridge (maintain a stock).

2. Hydraulic Oil Change

a. After 500 operating hours (1st oil change)
b. After 2000 operating hours (2nd oil change)
c. Thereafter every 2000 operating hours or annually irrespective of operating hours achieved

The oil change should be carried out with the system in warm running condition. Before re-filling, the reservoir should be cleaned to remove any oil sludge.

Caution: Rags or other threading material must not be used.

Note: The recommended interval between oil changes is based on various factors and should be carried out according to the type of fluid, the degree of aging, and contamination of the fluid. The water content is also a contributory factor.

Under application conditions with a heavy occurrence of dust or severe temperature fluctuations, the intervals between oil changes should be shortened accordingly.

Caution: Practical experience shows that most maintenance errors occur during an oil change due to:
a. Use of an unsuitable hydraulic oil
b. Use of oil contaminated due to faulty storage
c. Failure to clean reservoir
d. Inadequate cleanliness when filling (dirty drums or containers)

3. Leakage Inspection

1. After commissioning
2. The complete transmission (pump, motor and all pipelines, filters, valves, etc.) should be checked for leakage at regular intervals.

Caution: Leaking joints and connections must only be tightened in pressureless conditions.

4. Cleanliness Inspection

The oil tank breather should be regularly cleaned of dirt and dust to prevent clogging. The cooling surfaces should be cleaned at the same time.

Caution: If hose couplings are used in the high pressure lines, it is imperative that the utmost care be taken that no foreign bodies infiltrate the oil circuit when coupling and uncoupling (danger of damage to rotary group, and even possibility of total breakdown).

5. Oil Level Inspection

Inspect oil level in reservoir after commissioning, thereafter daily.

Caution: Top up only with specified oil type.
Do not mix fluids.

Hydraulic Fluids

Most good quality, mineral oil based, hydraulic fluids exhibiting the following characteristics are suitable for use in a Rexroth hydrostatic transmission.

Good antiwear performance
Resistant to oxidation degredation
Protection against rust and corrosion
Resistance to foaming
Ability to separate water rapidly
Suitable for widely varying temperature conditions
Good low temperature flow properties
Retains viscocity-temperature characteristics in service
Universally available

The prime consideration in the selection of hydraulic fluid is the expected oil temperature extremes that will be experienced in service. These extremes should be considered when selecting a fluid so that the most suitable temperature—viscosity characteristics—are obtained.

The fluid chosen should permit the system to operate within the following viscosity ranges.

Maximum viscosity at start-up	4600 SUS (1000 cSt)
Normal operating viscosity range	66-464 SUS (12-100 cSt)
Optimum viscosity range	81-141 SUS (16-30 cSt)
Absolute minimum viscosity	60 SUS (10 cSt)

When the fluid viscosity is greater than 1000 SUS (216 cSt) the transmission should be operated at reduced speed until the oil has been warmed to a temperature of 40°F. (4.5°C).

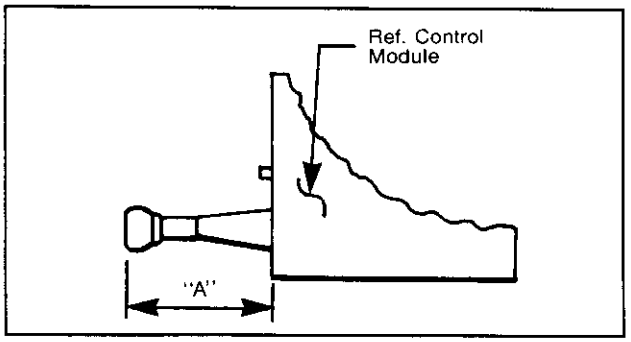
For applications that will operate near the extremes of viscosity and/or temperature, the fluid manufacturer should be consulted for assistance in selection of the most suitable type and grade of fluid for your application.

Rexroth strongly recommends the selection and use of fluids from reputable and established suppliers.

Control Module Size

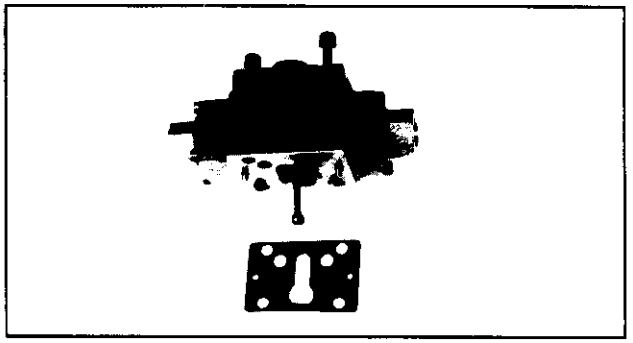
The servo feedback lever length (dimension "A") varies with pump size. The dimension can be checked to determine the control module size.

Pump Size	"A" Dimension (In.)
40	.85
56	1.03
90	1.25
125	1.43



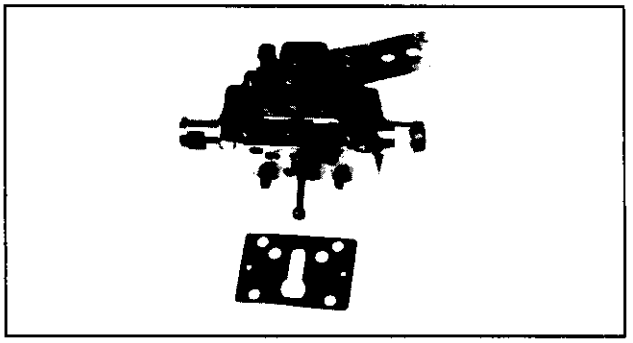
Remote Hydraulic Pilot Control Module, Type HD*

Pump Size	Part No.
40	5411-552-001
56	5421-552-001
90	5441-552-001
125	5451-552-001



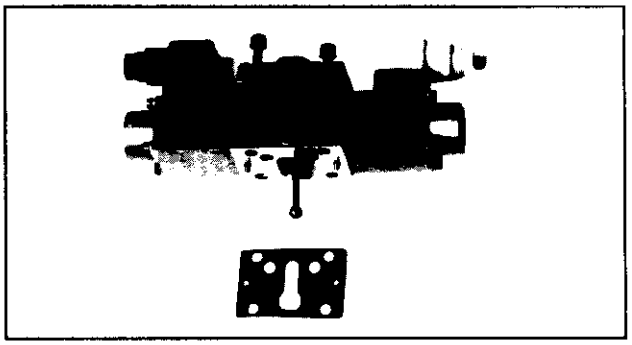
Manual Rotary Servo Control Module, Type HW*

Pump Size	Part No.
40	5412-552-001
56	5422-552-001
90	5442-552-001
125	5452-552-001



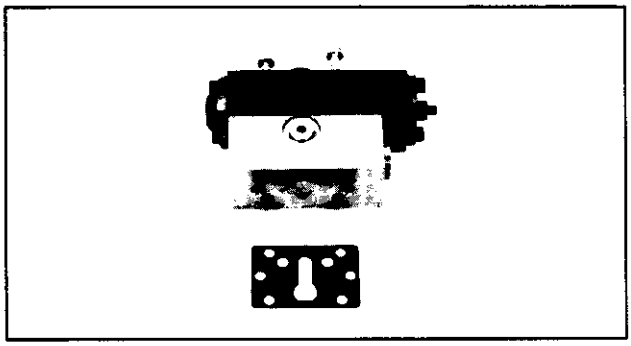
Proportional Electric Control Module, Type EL*

Pump Size	24 Volt DC Part No.	12 Volt DC Part No.
40	5413-552-001	5413-552-002
56	5423-552-001	5423-552-002
90	5443-552-001	5443-552-002
125	5453-552-001	5453-552-002



Non-Proportional Electric Control*

Pump Size	24 Volt DC Part No.	12 Volt DC Part No.
With P.O.R.	5406-552-003	5406-552-004
Without P.O.R.	5406-552-001	5406-552-002



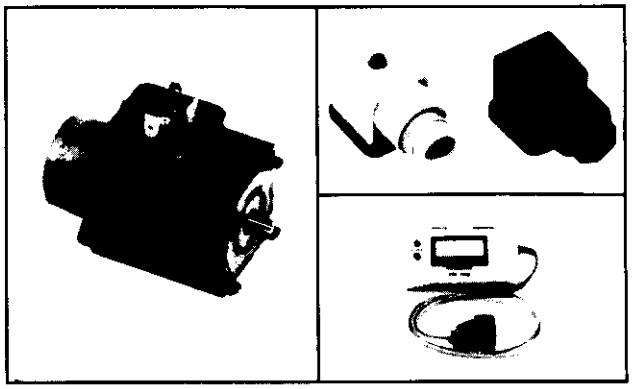
Without Control Module With P.O.R., Type HM*

Pump Size	Part No.
All	5407-552-001

*All control module mounting bolts require a 5mm allen wrench and a torque of 90 in-lbs.

Proportional Solenoids

Pump Size	24 Volt DC Part No.	12 Volt DC Part No.
All	5403-580-001	5403-580-002

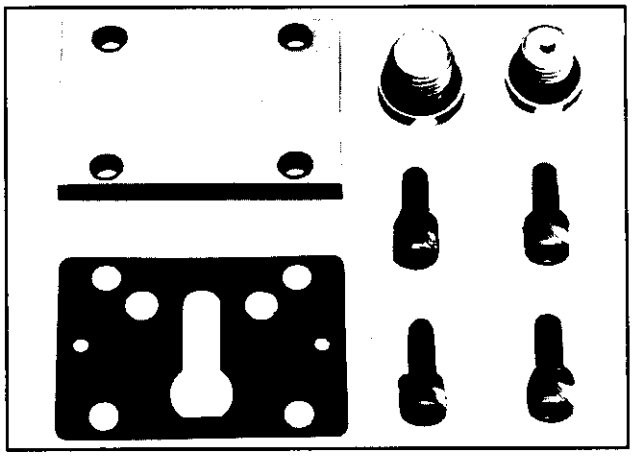


Non-Proportional Solenoids

Pump Size	24 Volt DC Part No.	12 Volt DC Part No.
All	5406-580-001	5406-580-002

Plug-In Connectors

Pump Size	Solenoid A Gray Color	Solenoid B Black Color
All	5400-085-001	5400-085-002

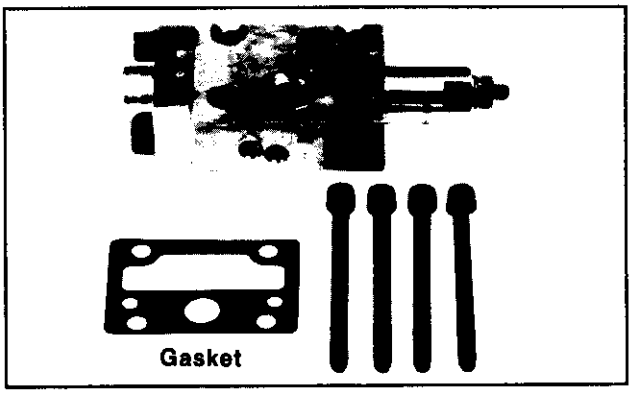


Ammeter With Sandwich Plug

Pump Size	Part No.
All EL Controls	5956-001-018

Conversion Kit OV Control

Pump Size	Part No.
All	5404-635-001



Pressure Override Valve (P.O.R.) For HD & EL Controls (includes gasket & bolts)

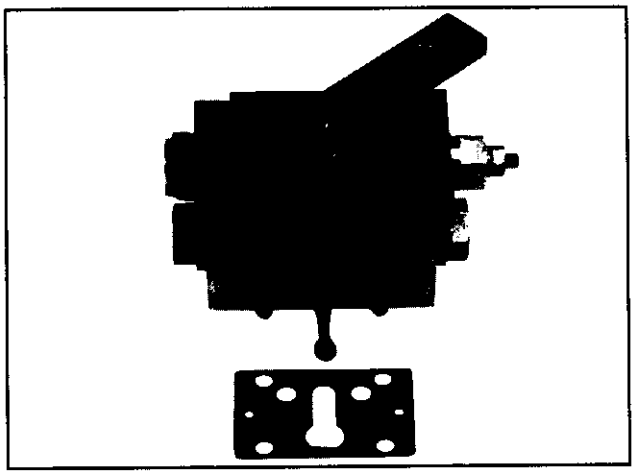
Pump Size	Part No.
All	5400-552-002

NOTE: A new control pipe and a high pressure pipe is required with the P.O.R. These can be found on Page 25.

Gasket Only (for P.O.R.)

Pump Size	Part No.
All	5400-082-002

NOTE: This is not the same gasket used on other control module kits. Control module gasket can be ordered from Page 26.

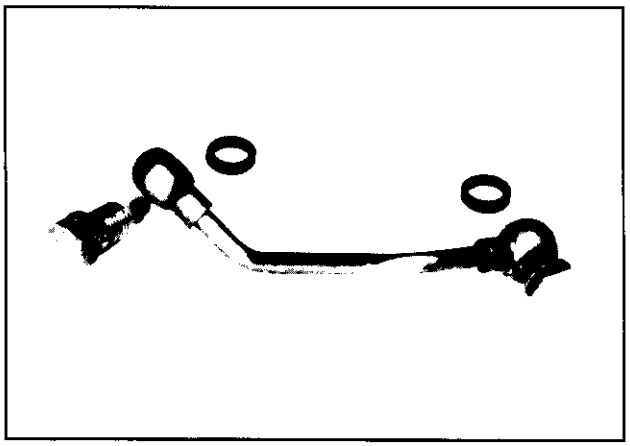


Manual Rotary Servo Control (HW) Module With Integral P.O.R.

Pump Size	Part No.
40	5412-552-002
56	5422-552-002
90	5442-552-002
125	5452-552-002

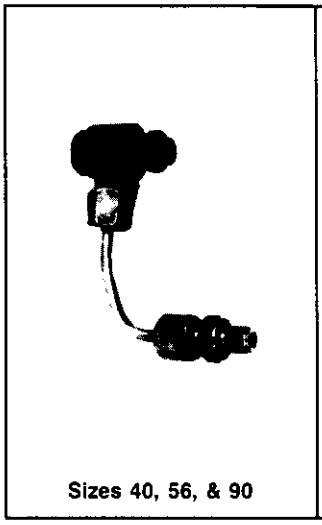
Control Pipe With Fittings

Pump Size	P.O.R.	HD & EL Controls	HW Control
40	WITHOUT	5410-635-001	5412-635-001
	WITH	5410-635-004	5410-635-004
56	WITHOUT	5420-635-001	5422-635-001
	WITH	5420-635-004	5420-635-004
90	WITHOUT	5440-635-001	5442-635-001
	WITH	5440-635-004	5440-635-004
125	WITHOUT	5450-635-001	5452-635-001
	WITH	5450-635-004	5450-635-004

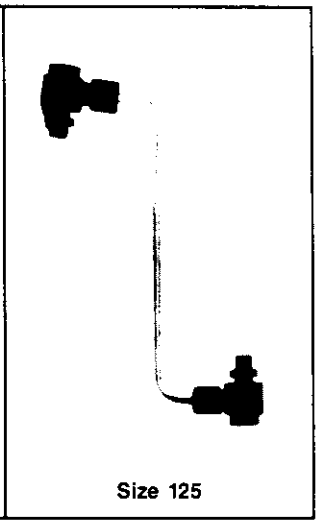


High Pressure Pipe With Fittings P.O.R. To Check Valves

Pump Size	Part No.
40	5410-635-005
56	5420-635-005
90	5440-635-007
125	5450-635-005



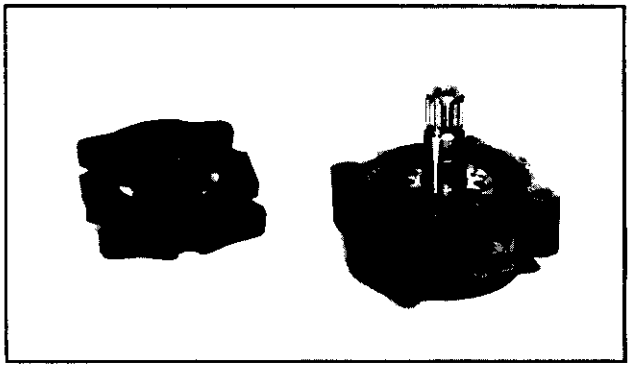
Sizes 40, 56, & 90



Size 125

Charge Pump

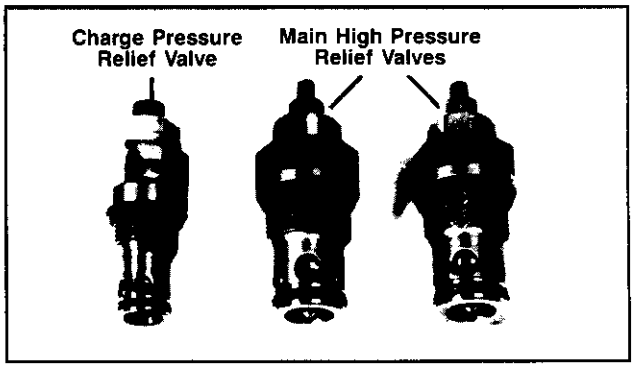
Pump Size	Part No.
40	5410-430-001
56	5420-430-001
90	5440-430-001
125	5450-430-001



Relief Valve Cartridge

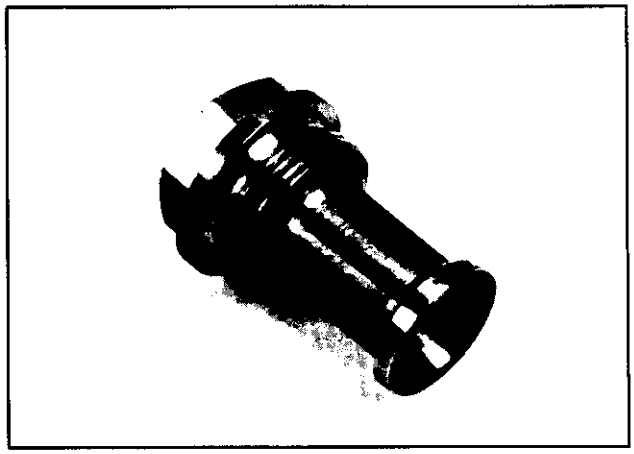
Pump Size	Main Relief		Charge Relief Part No.
	Pressure Range	Part No.	
40	2600-6000 psi	5400-566-011	5400-566-004
	1160-4640 psi	5400-566-013	
56	2600-6000 psi	5400-566-011	5400-566-004
	1160-4640 psi	5400-566-013	
90	2600-6000 psi	5400-566-012	5440-566-007
	1160-4640 psi	5400-566-012	
125	2600-6000 psi	5450-566-006	5450-566-007
	1160-4640 psi	5450-566-008	

NOTE: Maximum setting on charge relief is 580 psi.



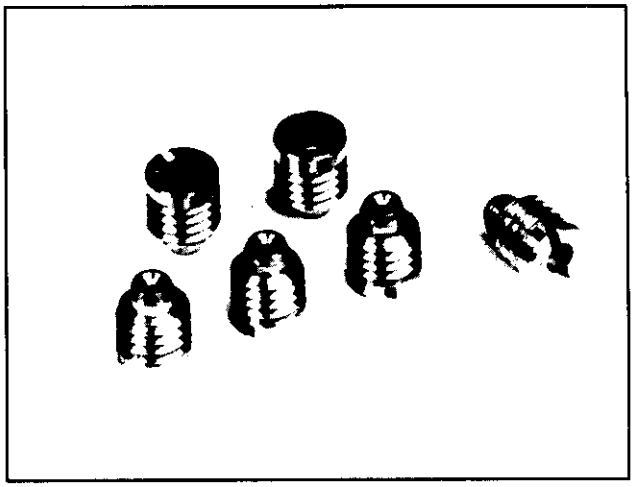
Sleeve Adapter For External Charge Flow Filtering

Pump Size	Part No.
40	5400-083-001
56	5400-083-001
90	5440-083-001
125	5450-083-001



Stroking Time Orifices

Size	Part No.
0.7	H156491
0.8	H156492
1.0	H156493
1.2	H156494
1.4	H156495



Seal Kits

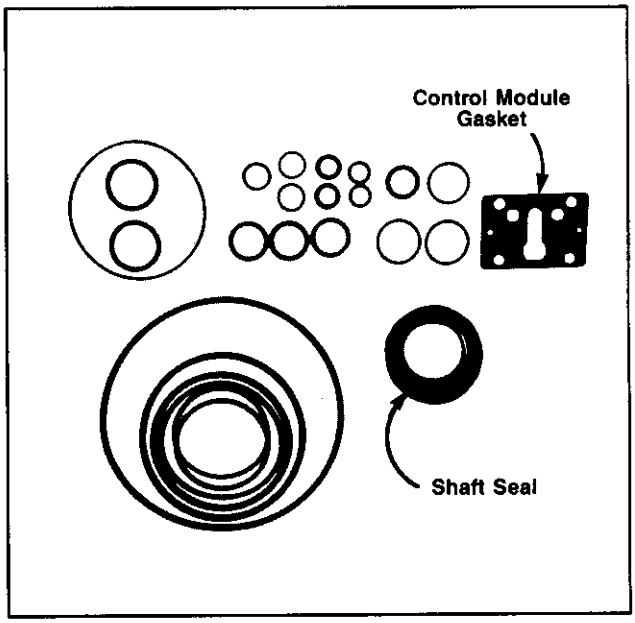
Pump Size	Part No.
40	5410-635-002
56	5420-635-002
90	5440-635-002
125	5450-635-002

Shaft Seal Only

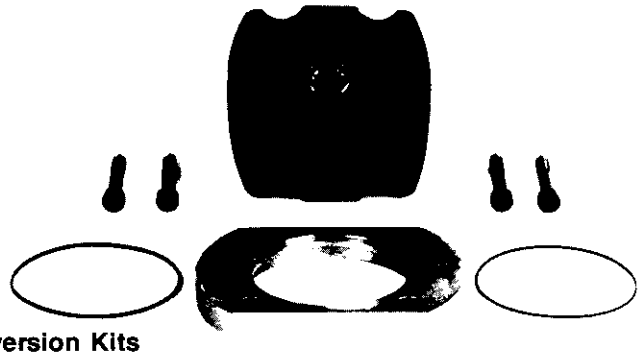
Pump Size	Part No.
40	5000-076-023
56	5000-076-021
90	5000-076-015
125	5000-076-004

Control Module Gasket Only

Pump Size	Part No.
All	5400-082-001

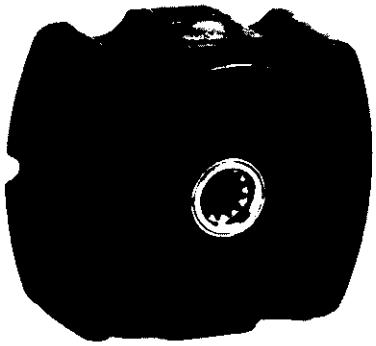


Through Drive Conversion Kit & Parts



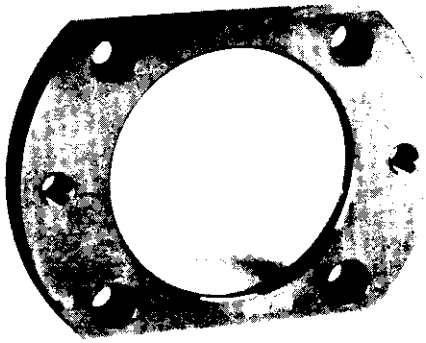
Through Drive Conversion Kits

Through drive	Pump Size			
	40	56	90	125
SAE A (Code C)	5410-635-003	5420-635-003	5440-635-003	5450-635-010
SAE B (Code G)	5410-635-010	5420-635-010	5440-635-005	5450-635-003
SAE B-B (Code J)	5410-635-011	5420-635-011	5440-635-012	5450-635-012
SAE C (Code M)			5440-635-015	5450-635-014



Through Drive Charge Pump

Through drive	Pump Size			
	40	56	90	125
SAE A (Code C)	5410-430-003	5420-430-003	5440-430-003	5450-430-005
SAE B (Code G)	5410-430-004	5420-430-004	5440-430-004	5450-430-003
SAE B-B (Code J)	5410-430-004	5420-430-004	5440-430-004	5450-430-006
SAE C (Code M)			5440-430-005	5450-430-007



Adapter Flange Kit

Through drive	Pump Size			
	40	56	90	125
SAE A (Code C)	5410-635-008	5420-635-008	5440-635-010	5450-635-008
SAE B (Code G)	5410-635-009	5420-635-009	5440-635-011	5450-635-009
SAE B-B (Code J)	5410-635-012	5420-635-012	5440-635-013	5450-635-013
SAE C (Code M)			5440-635-014	5450-635-015

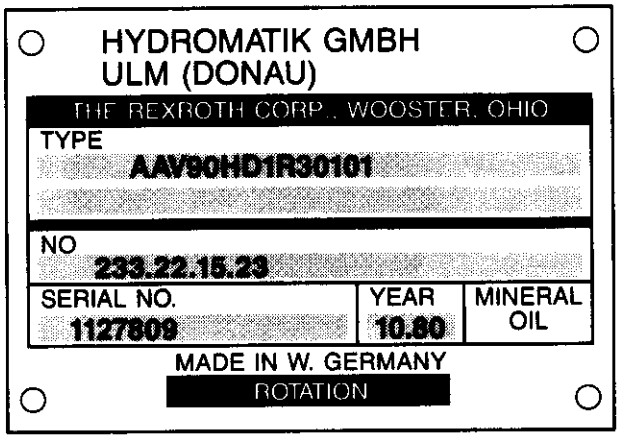
NOTE:
Kit includes bolts, O-rings and spline adapter (if required) to mount flange to through drive charge pump.

Ordering of AA4V Subassemblies

For Rexroth to supply the correct parts for your unit, please include all of the following information with your parts order.

TYPE CODE
TYPE NUMBER
SERIAL NUMBER
PART NUMBER
PART NAME

Due to modifications and improvements to our products, minor changes can occur to the parts, even though the type code may not necessarily reflect these changes. The type number and serial number will guarantee that the correct parts for your unit are supplied.



ORDERING EXAMPLE

To order a replacement charge pump for an AA4V hydrostatic transmission pump having the above nameplate, the following information would be required.

+	Type Code	AA4V90HD1R30101
+	Type Number	233.22.15.23
+	Serial Number	1127809
*	Part Number	5440-430-001
*	Part Name	Charge pump

+ This information is taken from the nameplate on the pump.
*This information is taken from Pages 23 through 27 of this publication.

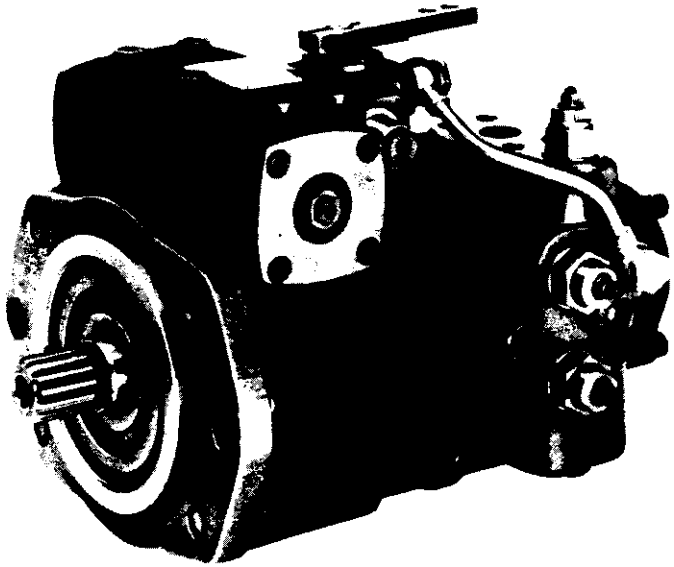
REXROTH
WORLDWIDE HYDRAULICS

Hydrostatic Transmission Pump
Type AA4V
Controls HD, HW, EL, OV, & HM

Sizes 40 to 125	Up to 6000 psi	2.44 to 7.63 in³/rev.

RA 06 200/5.89

Replaces: 1.86



Description

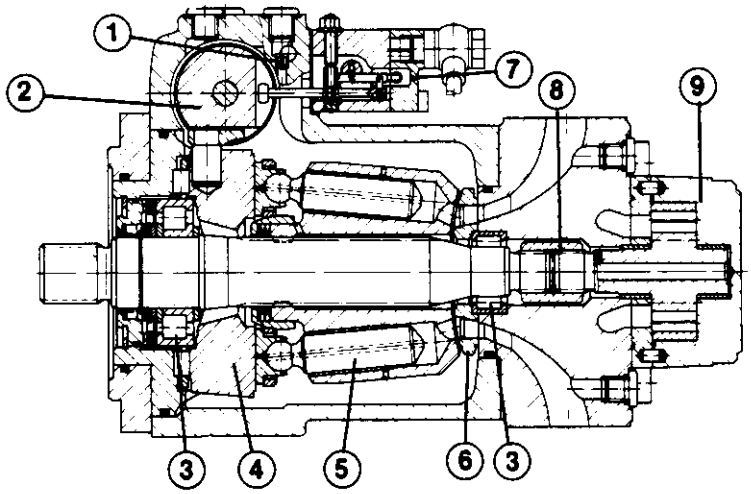
The AA4V is a swashplate design, variable displacement, over center, axial piston pump that has been designed exclusively for closed circuit hydrostatic transmissions where a self-contained pump package is required.

The pump design incorporates a charge pump, a charge pressure relief valve, and two combination high pressure relief and make-up check valves.

Features

- High power to weight ratio
- High volumetric efficiency due to the spherical control plate.
- Heavy duty service capability
- "State of the art" design
- Compact size
- Lightweight
- Low noise levels
- SAE mounting flange and spline shaft
- SAE high pressure and threaded ports
- High strength cast iron housing
- Many control options available

Construction



1. Stroking time orifice (2 per pump)
2. Control piston
3. Heavy duty roller bearings
4. Rocker cam swashplate
5. Inclined pistons
6. Spherical control plate
7. Control module
8. Spline coupling
9. Internal gear charge pump

Type Code

AA4V	56	EL	1	R	3	0	2	0	1	0 / 12VDC-TP-CV

Model

Axial Piston, Variable Displacement Pump — AA4V

Size

2.44 in³/rev 40 cm³/rev	40
3.42 in³/rev 56 cm³/rev	56
5.49 in³/rev 90 cm³/rev	90
7.63 in³/rev 125 cm³/rev	125

Controls

Remote hydraulic pilot	HD
Manual rotary servo	HW
Proportional electric	EL
Non-proportional Electric	EL/NP
Without control module	OV
Without control module with P.O.R.	HM

Design Series No.

Sizes, 40, 56, 90 & 125	1

Direction of Rotation

Right hand (clockwise)	R
Left hand (counter-clockwise)	L

(As viewed at shaft end)

Mounting Configuration

Sizes 40 and 56, SAE 'C' 2-bolt Flange, 14T, 12/24 Pitch, 30° Involute, Tol. CL.5, Spline Shaft. ANSI B92.1a	3
Size 90 SAE 'D' 2-bolt Flange, 14T, 12/24 Pitch, 30° Involute, Tol. CL.5, Spline Shaft. ANSI B92.1a	3
Size 125, SAE 'D' 2-bolt Flange, 13T, 8/16 Pitch, 30° Involute, Tol. CL.5, Spline Shaft. ANSI B92.1a	3

**Refer to the relevant data sheet for torque limitations and dimensional details of through drive

Model Number Example—AA4V56EL1R302010/12VDC-TP-CV

Variable displacement hydrostatic transmission pump, type AA4V, size 56, remote proportional electric control (12VDC) control, series 1, right-hand rotation, SAE 'C' mounting flange, 14 teeth—12/24 pitch, spline shaft, porting for external charge flow filter, relief valve adjustment range of 2600 to 6000 psi, without pressure override, tamper proof caps on adjustment screws and with high pressure shuttle checks.

Additional Information

(in clear text)

1) For EL control, advise required control voltage. Standard = 24 VDC volts DC Optional = 12 VDC volts DC
2) For tamper proof caps on adjustment screws show TP.
3) For P.O.R. checks but without the P.O.R. show CV.
4) For neutral start switch (HW control only) show NSS.
5) For larger charge pump (size 40 only) show LCP.
6) For viton shaft seal show V.
7) For auxiliary Y-Port for remote inching show Y.

Pressure Override (P.O.R.) Option

Without pressure override	0
With pressure override (Pressure override is standard with HM control)	1

High Pressure Relief Valves

With pilot operated relief valves adjustable in range of 2600 to 6000 psi (Standard design)	1
With pilot operated relief valves adjustable in range of 1160 to 2600 psi.	2

Speed Sensing Horsepower Limiter

For use with diesel or gasoline engines only. Not available with OV control.

Without S.S.H.L. control cartridge (Standard design)	0

For S.S.H.L. see brochure RA06202

Filter Port Options

With porting for suction Filter Only (Standard)	1
With porting for external charge flow filter (If external charge flow filtration is required with S.S.H.L., contact Rexroth for details)	2
With direct mounted filter (supplied with AA4V) Contact Rexroth for details and availability	5

Through Drive For Auxiliary Pump**

Without through drive for auxiliary pump	0
Without charge pump & without through drive	E
With charge pump & SAE A, 2-bolt through drive	C
With charge pump & SAE B, 2-bolt through drive	G
With charge pump & SAE B-B, 2-bolt through drive.	J
With charge pump & SAE C, 2-bolt through drive. Size 90 & 125 Only.	M

Technical Details

General Specifications AA4V Pump

SPECIFICATION	Unit	AA4V40	AA4V56	AA4V90	AA4V125
Displacement	in³/rev	2.44	3.42	5.49	7.63
	cm³/rev	40	56	90	125
Nominal flow at	gpm	10.56	14.80	23.77	33.00
1000 rpm	l/min	40	56	90	125
Maximum Pressure	psi	6000	6000	6000	6000
	bar	414	414	414	414
Torque constant	lb ft/100 psi	3.23	4.53	7.28	10.12
	Nm/bar	0.636	0.89	1.44	1.98
Maximum allowable	lb ft	305	381	473	1007
shaft torque	Nm	414	517	641	1367
Maximum drive speed	rpm	3700	3400	2900	2500
Minimum drive speed	rpm	500	500	500	500
Weight (approx. Varies	lbs	64	77	112	154
with control type)	Kg	29	35	51	70
Moment of Inertia	lb-in²	16.72	29.01	59.73	102.4
	Kgm²	0.0049	0.0085	0.0175	0.03
Maximum case pressure	psi	29	29	29	29
	bar	2	2	2	2
Maximum permissable	F_A lbs	337	494	786	1078
external loading of	N	1500	2200	3500	4800
the drive shaft	F_R lbs	809	1124	1798	2472
	N	3600	5000	8000	11,000

Charge Pump

Displacement	in³/rev	0.51	0.70	1.16	1.61
	cm³/rev	8.4	11.4	19.0	26.4
Nominal flow at	gpm	2.20	3.03	5.02	6.97
1000 rpm	l/min.	8.4	11.4	19.0	26.4
Nominal pressure	psi	320	320	320	320
	bar	22	22	22	22
Maximum pressure	psi	580	580	580	580
	bar	40	40	40	40
Minimum inlet pressure	psig	-3.2	-3.2	-3.2	-3.2
(at normal operating temp.)	bar(absolute)	0.8	0.8	0.8	0.8

SIZES 71 & 250 ARE DETAILED IN RA 06210

Description . . . The AA4V is a swashplate design, variable displacement, over center, axial piston pump manufactured by the Hydromatik Division of Rexroth.

The AA4V has been designed exclusively for closed circuit hydrostatic transmissions where a self-contained pump package is required. The pump design incorporates a charge pump, a charge pressure relief valve, and two combination high pressure relief and make-up check valves.

The control options are of modular design to allow interchangeability without altering the basic pump. The three basic displacement controls are:

remote hydraulic pilot	(type HD)
manual rotary servo	(type HW)
proportional electric	(type EL)

A complete range of control accessories is available to extend the control versatility of this pump.

Installation . . . . . the AA4V pump may be mounted in any position around the horizontal axis. The horizontal axis (drive shaft) may be tilted to 15° in either direction from the horizontal.

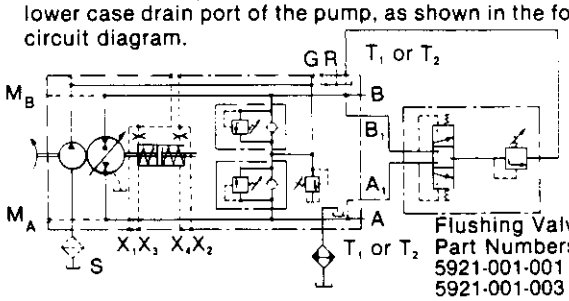
The AA4V transmission pump is usually face mounted to a drive gear box with the shaft engaging a mating female splined gear hub, or spline adapter. The large drive shaft bearings permit the pump to be driven by vee or toothed belt drives. The case drain line should be connected to the highest case drain port (T_1 or T_2) so that the pump case always remains full of oil. The case drain return piping, or hose, should be sized to accept the full flow of the charge pump at the maximum anticipated drive speed.

For mobile applications the oil reservoir capacity required (in US gallons) is generally .75 to 1 times the charge pump flow (in US gallons per minute) for a one pump, one motor transmission. The heat exchanger should be located between the pump case drain and the reservoir, and sized to accept the full flow of the charge pump at the maximum anticipated drive speed.

Flushing Circuit . . . When one variable pump and one motor is used, a flushing valve is not normally required unless continuous high speed and/or high pressure is anticipated. In this case, flushing may be required through the motor case as well as the pump case (see note below):

Whenever any type of valves, such as directional control valves or flow divider valves, are used in the closed loop circuit, a system flushing valve is recommended.

NOTE: All charge pump flow must flow through the pump case when the transmission is in neutral and the pump is rotating. If a circuit flushing valve (hot oil shuttle valve) is used, the outlet port of this valve must be connected to the lower case drain port of the pump, as shown in the following circuit diagram.



Flushing Valve
Part Numbers:
5921-001-001 (metric)
5921-001-003 (SAE)

Filtration....There are 3 options available for the filtration of the hydraulic fluid used in the AA4V pump.

a) a suction filter between the oil reservoir and the charge pump.

b) an external low pressure charge flow filter (customer supplied) between the charge pump and make up check valves.

c) a built on low pressure, charge flow filter between the charge pump and make up check valves. (contact Rexroth for details and availability)

Option (b) is recommended, however, the final decision is with the pump user, based on the application.

See page 15 of this brochure for details of the above 3 options.

Fluid Recommendations . . . the AA4V pumps are supplied as standard for use with good quality, petroleum based, hydraulic fluids.

The prime consideration in the selection of a hydraulic fluid, is the expected oil temperature extremes that will be experienced in service. These extremes will govern the selection of a fluid with the most suitable temperature-viscosity characteristics.

When there is a question of the suitability of a particular fluid, or for applications which will operate near the extremes of viscosity or temperature, the oil manufacturer should be consulted.

Viscosity Ranges . . . the hydraulic fluid selected should operate with the following viscosity ranges.

Maximum viscosity at start-up	4600 SSU (1000 cSt)
Normal operating viscosity range	66-464 SSU (12-100 cSt)
Optimum viscosity range	81-141 SSU (16-30 cSt)
Absolute minimum viscosity	60 SSU (10 cSt)

Operating Temperature . . . -13 °F to + 195 °F (-25 °C to 90 °C). The temperature level of a particular system is normally measured at the pump or motor case drain. This temperature is then used to establish the cooling requirements for the system.

Start-Up . . . the pump case must be filled with oil, and where possible, all piping and hoses should be filled with oil prior to the first start-up.

The pump control should be set at zero stroke for start-up.

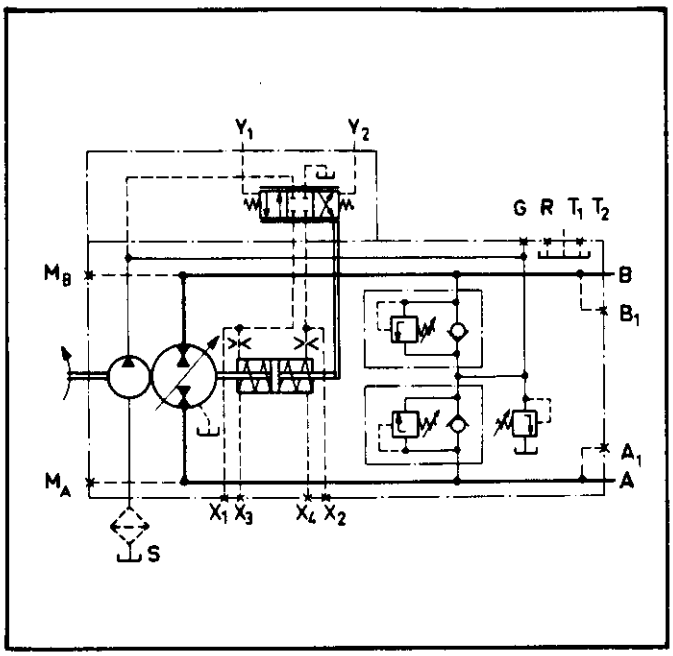
Before running the pump at full speed the drive should be jogged until a charge pressure of at least 50 psi is established.

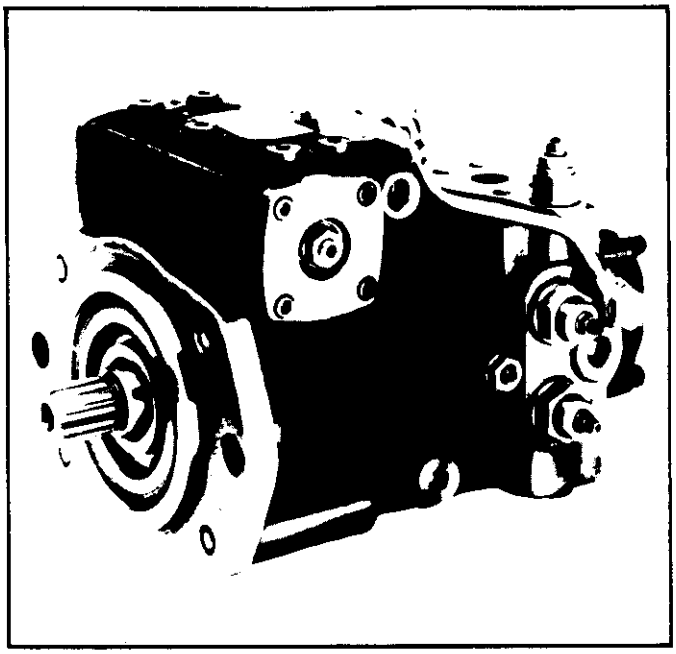
Applications vary and therefore the most suitable start-up method should be selected for the application.

MORE DETAILED INFORMATION ON MOUNTING POSITION, INSTALLATION, FILTRATION, FLUIDS AND START-UP PROCEDURES, IS AVAILABLE IN A SEPARATE PUBLICATION TITLED 'AA4V APPLICATION AND SERVICE MANUAL'.

Control Description

Remote Hydraulic Pilot Control, Type HD





The flow output of the pump is infinitely varied in the range of 0 to 100%, proportional to a low pressure pilot signal, in the range of 85 to 260 psi, applied at port Y_1 or Y_2.

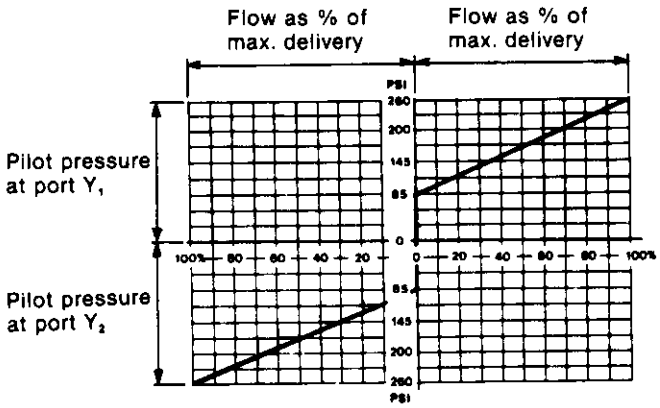
The pilot signal, which originates from an external, remote source, is pressure only. Flow is negligible as the pilot signal is only acting on the spool of the control valve.

This spool then directs control oil, in and out of the control cylinder to stroke the pump as required.

A feedback lever, connected to the control piston, maintains the pump flow for any given pilot signal.

With no command signal at Y_1 or Y_2, the control is in the neutral (zero flow) position preventing transmission output.

The REXROTH TH7 remote control, lever and foot pedal operated pilot valves, may be used directly with this pump control.



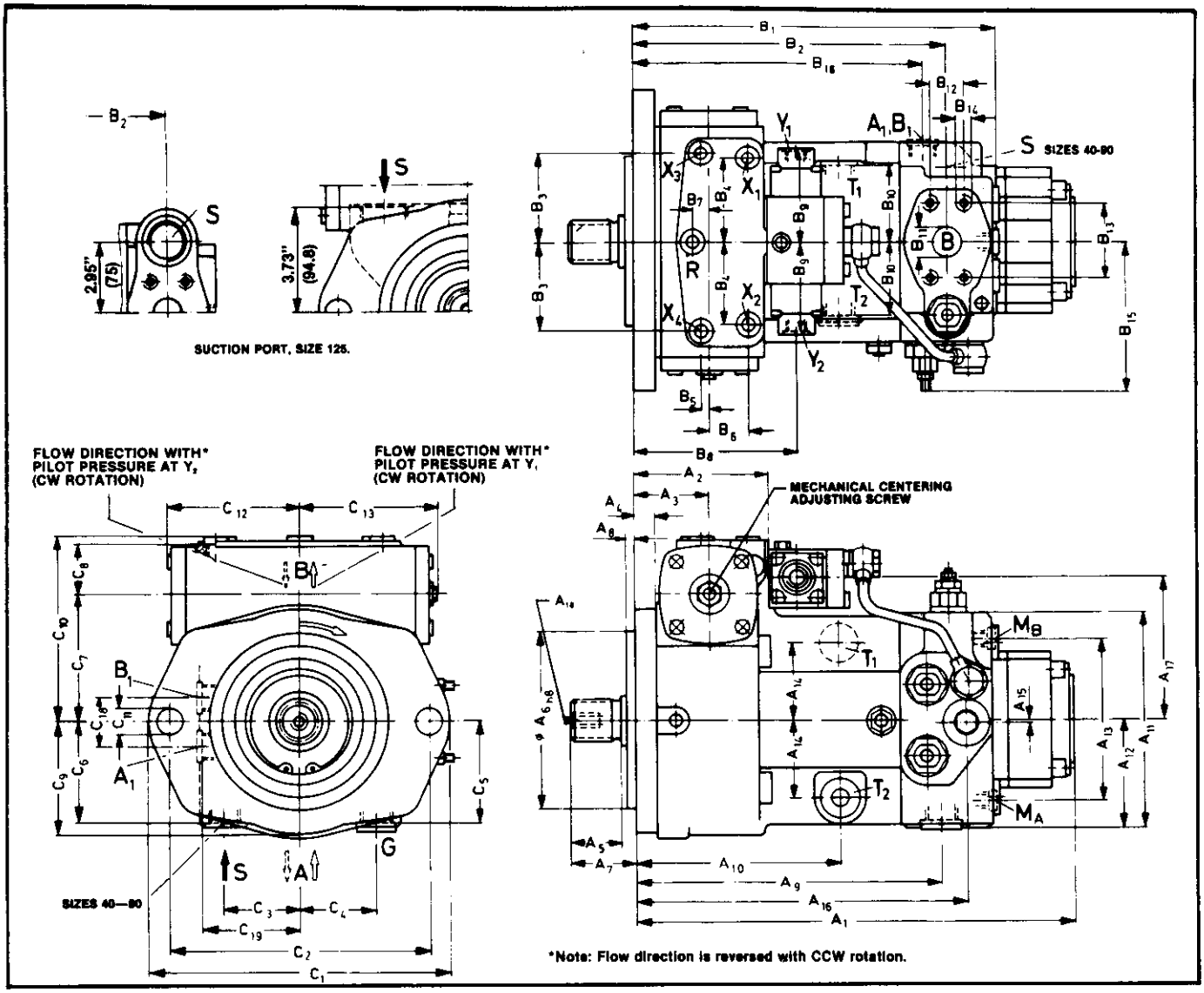
STANDARD STROKING TIMES		40	56	90	125
Zero to max. displ.	(sec)	1.0	1.0	1.2	1.2
Max. displ. to zero	(sec)	1.0	1.0	1.2	1.2

"Faster or slower stroking times are possible by changing the size of the stroking time orifices"

PORT DESIGNATIONS & SIZES		Size 40 & 56	Size 90	Size 125
A, B	— Service ports	SAE 3/4"-6000 psi	SAE 1"-6000 psi	SAE 1¼"-6000 psi
A_1, B_1	— Auxiliary service ports	3/4 "-16 UNF	3/4 "-16 UNF	3/4"-16 UNF
S	— Charge pump suction port	7/8 "-14 UNF	1-3/16"-12 UNF	1-5/8"-12 UNF
G	— Charge pump access port	7/8 "-14 UNF	1-1/16"-12 UNF	1-1/16"-12 UNF
T_1, T_2	— Case drain ports	7/8 "-14 UNF	1-1/16"-12 UNF	1-5/16"-12 UNF
M_A, M_B	— High pressure gage ports	7/16"-20 UNF	7/16"-20 UNF	7/16"-20 UNF
R	— Case vent port	7/16"-20 UNF	7/16"-20 UNF	7/16"-20 UNF
X_1, X_2	— Control pressure gage ports (before control orifices)	7/16"-20 UNF	7/16"-20 UNF	7/16"-20 UNF
X_3, X_4	— Control Pressure gage ports (after control orifices)	7/16"-20 UNF	7/16"-20 UNF	7/16"-20 UNF
Y_1, Y_2	— Pilot pressure ports	9/16"-18 UNF	9/16"-18 UNF	9/16"-20 UNF

Installation Dimensions

Pump Sizes 40, 56, 90 and 125 With HD Control



Size	A_1	A_2	A_3	A_4	A_5	A_6	A_7	A_8	A_9	A_{10}	A_{11}	A_{12}	A_{13}	A_{14}	A_{15}	A_{16}	A_{17}	A_{18}	B_1	B_2	B_3	B_4	B_5	B_6	B_7
40	11.22	3.31	1.81	0.51	1.89	5.00	2.20	0.49	7.82	5.00	5.39	2.70	4.57	1.85	—	8.51	3.54	7/16-14	9.30	8.00	2.20	2.05	0.30	0.96	0.51
	285	**84**	**46**	**13**	**48**	**127**	**56**	**12.5**	**198.6**	**127.1**	**137**	**68.5**	**116**	**47**	**—**	**216.1**	**89.8**	UNC-2B	**236.1**	**203.1**	**56**	**52**	**7.5**	**24.5**	**13**
56	12.05	3.67	2.05	0.59	1.89	5.00	2.20	0.49	8.41	5.60	5.98	2.99	4.57	2.15	—	9.10	3.88	7/16-14	9.89	8.59	2.44	2.28	0.18	1.08	0.39
	306	**93.3**	**52**	**15**	**48**	**127**	**56**	**12.5**	**213.7**	**142.2**	**152**	**76**	**116**	**54.5**	**—**	**231.2**	**98.5**	UNC-2B	**251.2**	**218.2**	**62**	**58**	**4.5**	**27.5**	**10**
90	13.39	4.21	2.28	0.67	1.89	6.00	2.20	0.49	9.65	6.57	6.50	3.25	5.12	2.32	—	10.33	4.43	7/16-14	11.30	9.69	2.83	2.68	0.02	1.24	0.24
	340	**107**	**58**	**17**	**48**	**152.4**	**56**	**12.5**	**245**	**167**	**165**	**82.5**	**130**	**59**	**—**	**262.5**	**112.5**	UNC-2B	**287**	**246**	**72**	**68**	**0.5**	**31.5**	**6**
125	15.37	4.76	2.58	0.79	2.64	6.00	2.93	0.49	10.73	7.19	7.48	3.74	5.91	2.60	0.16	11.59	4.86	5/8-11	12.70	10.73	3.15	2.95	—	1.40	—
	390.5	**121**	**65.5**	**20**	**67**	**152.4**	**74.5**	**12.5**	**272.5**	**182.5**	**190**	**95**	**150**	**66**	**4**	**294.5**	**123.5**	UNC-2B	**322.5**	**272.5**	**80**	**75**	**—**	**35.5**	**—**

Size	B_8	B_9	B_{10}	B_{11}	B_{12}	B_{13}	B_{14}	B_{15}	B_{16}	C_1	C_2	C_3	C_4	C_5	C_6	C_7	C_8	C_9	C_{10}	C_{11}	C_{12}	C_{13}	C_{18}	C_{19}
40	4.07	2.58	1.95	0.75	0.94	2.00	3/8-16 UNC	4.26	7.41	8.39	7.13	2.05	2.09	2.50	2.68	3.10	1.44	2.80	4.70	0.69	3.37	3.50	1.34	2.48
	103.4	**65.5**	**49.5**	**19**	**23.8**	**50.8**	**0.63 DEEP**	**108.2**	**188.1**	**213**	**181**	**52**	**53**	**63.5**	**68**	**78.8**	**36.5**	**71**	**119.3**	**17.5**	**85.6**	**89**	**34**	**63**
56	4.44	2.58	2.07	0.75	0.94	2.00	3/8-16 UNC	4.26	8.00	8.39	7.13	2.05	2.09	2.81	2.80	3.44	1.50	3.07	5.12	0.69	3.61	3.74	1.34	2.68
	112.7	**65.5**	**52.5**	**19**	**23.8**	**50.8**	**0.63 DEEP**	**108.2**	**203.2**	**213**	**181**	**52**	**53**	**71.5**	**71**	**87.5**	**36**	**78**	**130**	**17.5**	**91.6**	**95**	**34**	**66**
90	4.98	2.58	2.44	0.98	1.09	2.25	7/16-14 UNC	4.74	9.06	10.51	9.00	2.32	2.36	3.09	3.09	4.00	1.67	3.54	5.87	0.81	4.08	4.41	1.34	3.07
	126.4	**65.5**	**62**	**25**	**27.8**	**57.2**	**0.63 DEEP**	**128.5**	**230**	**267**	**228.6**	**59**	**60**	**78.5**	**78.5**	**101.5**	**42.5**	**90**	**149**	**20.6**	**103.6**	**112**	**34**	**78**
125	5.53	2.58	2.68	1.26	1.25	2.63	1/2-13 UNC	5.22	9.98	10.51	9.00	—	2.68	3.54	—	4.43	1.81	3.84	6.44	0.81	4.88	5.12	1.42	3.60
	140.4	**65.5**	**68**	**32**	**31.8**	**66.7**	**0.82 DEEP**	**132.5**	**253.5**	**267**	**228.6**	**—**	**68**	**90**	**—**	**112.5**	**46**	**97.5**	**163.5**	**20.6**	**124**	**130**	**36**	**91.5**

Weights:

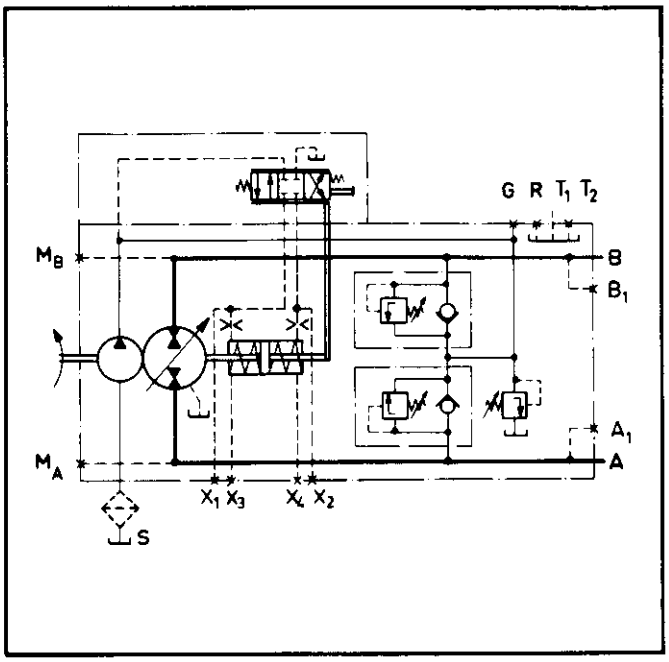
40	64 lbs. / 29 kg		90	112 lbs. / 51 kg	
56	77 lbs. / 35 kg		125	154 lbs. / 70 kg	

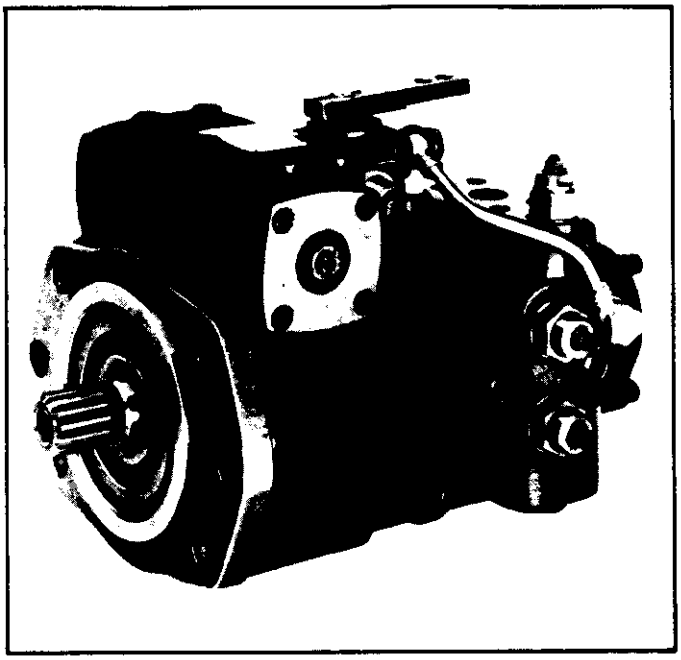
Note: See page 2 for spline data

Shaded dimensions are in millimeters.

Control Description

Manual Rotary Servo Control, Type HW





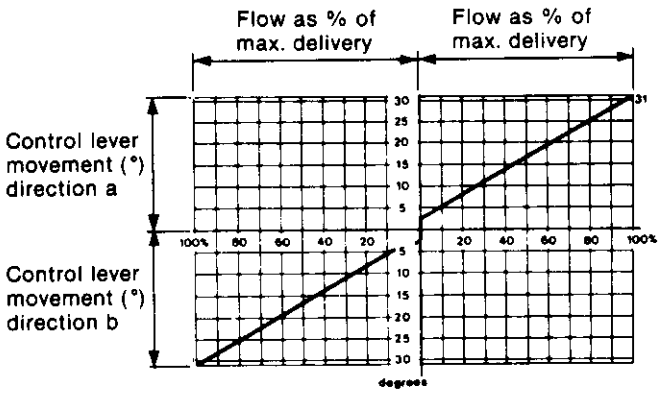
The flow output of the pump is infinitely varied in the range of 0 to 100%, proportional to the displacement of the control lever between 0° and 31°.

Flow from the pump is reversed by moving the lever from position 'a' to position 'b'.

A feedback lever, connected to the control piston, maintains the pump flow for any given position of the control lever between 0° and 31°.

The 'HW' control is suitable for use with push-pull cables and mechanical linkages.

The torque required to activate the control is **14...22 lb-in (160...250Ncm)**



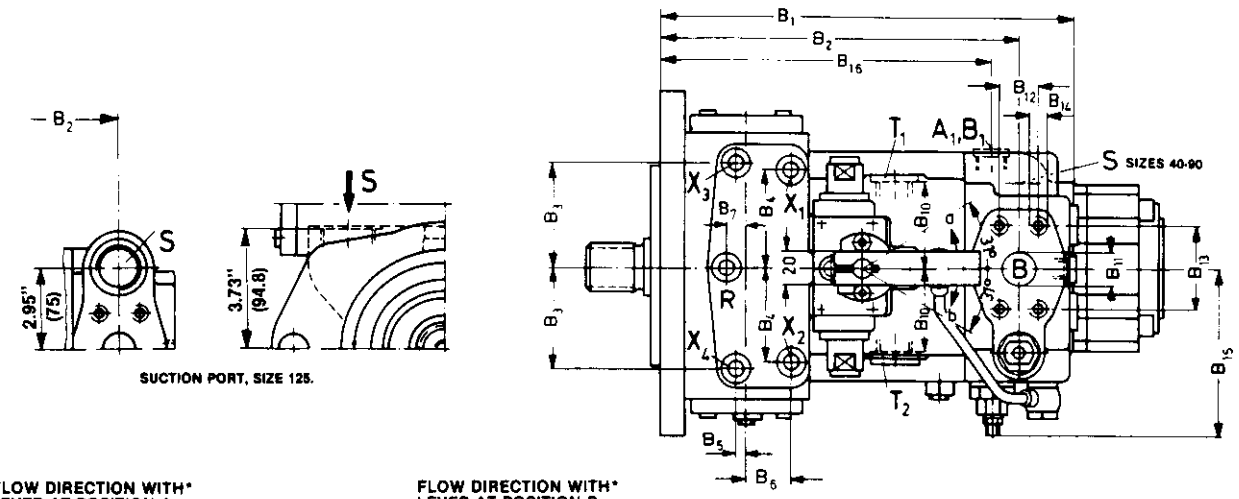
STANDARD STROKING TIMES		40	56	90	125
Zero to max. displ.	(sec)	1.0	1.0	1.2	1.2
Max. displ. to zero	(sec)	1.0	1.0	1.2	1.2

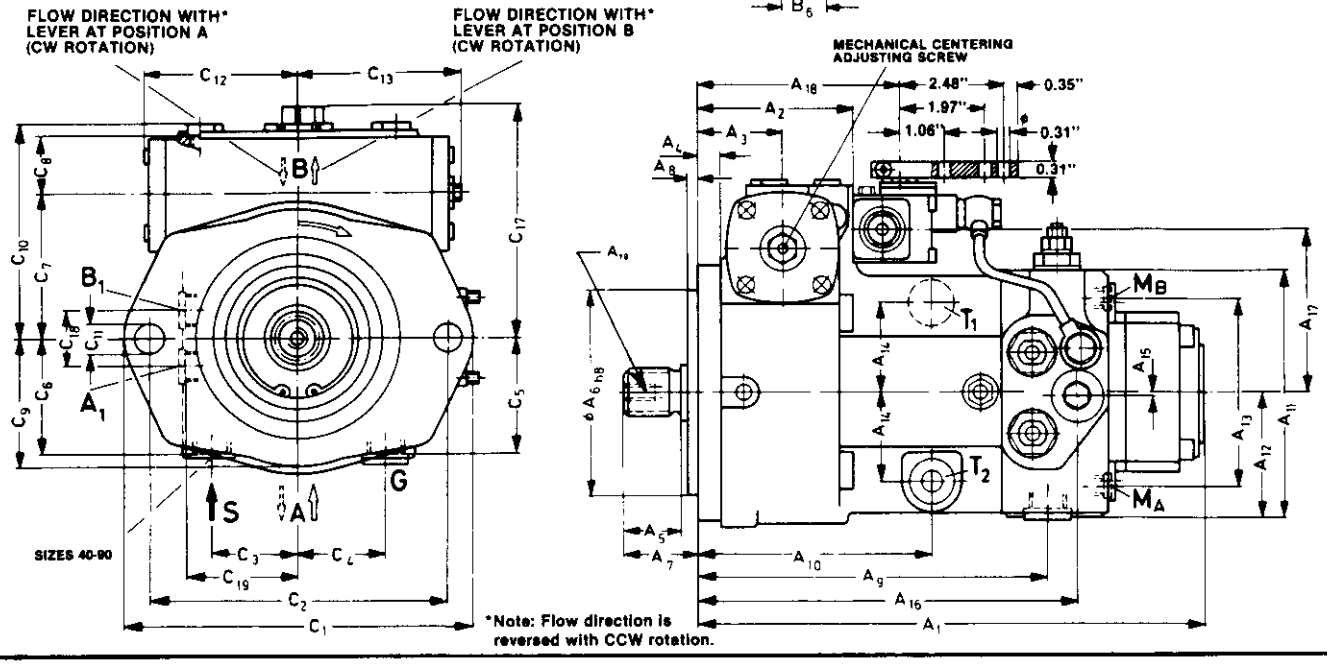
"Faster or slower stroking times are possible by changing the size of the stroking time orifices"

PORT DESIGNATIONS & SIZES		Size 40 & 56	Size 90	Size 125
A, B	— Service ports	SAE 3/4"-6000 psi	SAE 1"-6000 psi	SAE 1¼"-6000 psi
A_1, B_1	— Auxiliary service ports	3/4 "-16 UNF	3/4 "-16 UNF	3/4"-16 UNF
S	— Charge pump suction port	7/8 "-14 UNF	1-3/16"-12 UNF	1-5/8"-12 UNF
G	— Charge pump access port	7/8 "-14 UNF	1-1/16"-12 UNF	1-1/16"-12 UNF
T_1, T_2	— Case drain ports	7/8 "-14 UNF	1-1/16"-12 UNF	1-5/16"-12 UNF
M_A, M_B	— High pressure gage ports	7/16"-20 UNF	7/16"-20 UNF	7/16"-20 UNF
R	— Case vent port	7/16"-20 UNF	7/16"-20 UNF	7/16"-20 UNF
X_1, X_2	— Control pressure gage ports (before control orifices)	7/16"-20 UNF	7/16"-20 UNF	7/16"-20 UNF
X_3, X_4	— Control Pressure gage ports (after control orifices)	7/16"-20 UNF	7/16"-20 UNF	7/16"-20 UNF

Installation Dimensions

Pump Sizes 40, 56, 90 and 125 With HW Control





Size	A_1	A_2	A_3	A_4	A_5	A_6	A_7	A_8	A_9	A_{10}	A_{11}	A_{12}	A_{13}	A_{14}	A_{15}	A_{16}	A_{17}	A_{18}	A_{19}	B_1	B_2	B_3	B_4	B_5	B_6
40	11.22	3.31	1.81	0.51	1.89	5.00	2.20	0.49	7.82	5.00	5.39	2.70	4.57	1.85	—	8.51	3.54	4.51	7/16-14	9.30	8.00	2.20	2.05	0.30	0.96
	285	**84**	**46**	**13**	**48**	**127**	**56**	**12.5**	**198.6**	**127.1**	**137**	**68.5**	**116**	**47**	**—**	**216.1**	**89.8**	**114.5**	UNC-2B	**236.1**	**203.1**	**56**	**52**	**7.5**	**24.5**
56	12.05	3.67	2.05	0.59	1.89	5.00	2.20	0.49	8.41	5.60	5.98	2.99	4.57	2.15	—	9.10	3.88	4.87	7/16-14	9.89	8.59	2.44	2.28	0.18	1.08
	306	**93.3**	**52**	**15**	**48**	**127**	**56**	**12.5**	**213.7**	**142.2**	**152**	**76**	**116**	**54.5**	**—**	**231.2**	**98.5**	**123.8**	UNC-2B	**251.2**	**218.2**	**62**	**58**	**4.5**	**27.5**
90	13.39	4.21	2.28	0.67	1.89	6.00	2.20	0.49	9.65	6.57	6.50	3.25	5.12	2.32	—	10.33	4.43	5.41	7/16-14	11.30	9.69	2.83	2.68	0.02	1.24
	340	**107**	**58**	**17**	**48**	**152.4**	**56**	**12.5**	**245**	**167**	**165**	**82.5**	**130**	**59**	**—**	**262.5**	**112.5**	**137.5**	UNC-2B	**287**	**246**	**72**	**68**	**0.49**	**31.5**
125	15.37	4.76	2.58	0.79	2.64	6.00	2.93	0.49	10.73	7.19	7.48	3.74	5.91	2.60	0.16	11.59	4.86	5.96	5/8-11	12.70	10.73	3.15	2.95	—	1.40
	390.5	**121**	**65.5**	**20**	**67**	**152.4**	**74.5**	**12.5**	**272.5**	**182.5**	**190**	**95**	**150**	**66**	**4**	**294.5**	**123.5**	**151.5**	UNC-2B	**322.5**	**272.5**	**80**	**75**	**—**	**35.5**

Size	B_7	B_{10}	B_{11}	B_{12}	B_{13}	B_{14}	B_{15}	B_{16}	C_1	C_2	C_3	C_4	C_5	C_6	C_7	C_8	C_9	C_{10}	C_{11}	C_{12}	C_{13}	C_{17}	C_{18}	C_{19}
40	0.51	1.95	0.75	0.94	2.00	3/8-16 UNC	4.26	7.41	8.39	7.13	2.05	2.09	2.50	2.68	3.10	1.44	2.80	4.70	0.69	3.37	3.50	1.34	5.13	2.48
	13	**49.5**	**19**	**23.8**	**50.8**	**0.63 DEEP**	**108.2**	**188.1**	**213**	**181**	**52**	**53**	**63.5**	**68**	**78.8**	**36.5**	**71**	**119.3**	**17.5**	**85.6**	**89**	**130.3**	**34**	**63**
56	0.39	2.07	0.75	0.94	2.00	3/8-16 UNC	4.26	8.00	8.39	7.13	2.05	2.09	2.81	2.80	3.44	1.50	3.07	5.12	0.69	3.61	3.74	5.48	1.34	2.68
	10	**52.5**	**19**	**23.8**	**50.8**	**0.63 DEEP**	**108.2**	**203.2**	**213**	**181**	**52**	**53**	**71.5**	**71**	**87.5**	**38**	**78**	**130**	**17.5**	**91.6**	**95**	**139**	**34**	**68**
90	0.24	2.44	0.98	1.09	2.25	7/16-14 UNC	4.74	9.06	10.51	9.00	2.32	2.36	3.09	3.09	4.00	1.67	3.54	5.87	0.81	4.08	4.41	6.03	1.34	3.07
	6	**62**	**25**	**27.8**	**57.2**	**0.63 DEEP**	**120.5**	**230**	**267**	**228.6**	**59**	**60**	**78.5**	**78.5**	**101.5**	**42.5**	**90**	**149**	**20.6**	**103.6**	**112**	**153**	**34**	**78**
125	—	2.68	1.26	1.25	2.63	1/2-13 UNC	5.22	9.98	10.51	9.00	—	2.68	3.54	—	4.43	1.81	3.84	6.44	0.81	4.88	5.12	6.46	1.42	3.60
	—	**68**	**32**	**31.8**	**66.7**	**0.82 DEEP**	**132.5**	**253.5**	**267**	**228.6**	**—**	**68**	**90**	**—**	**112.5**	**46**	**97.5**	**163.5**	**20.6**	**124**	**130**	**164**	**36**	**91.5**

Weights:

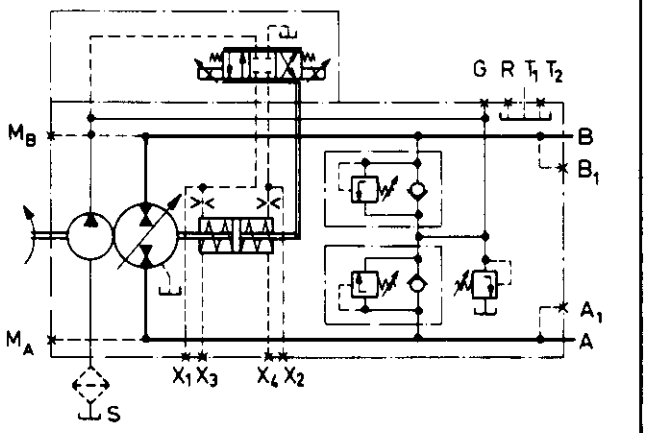
40	64 lbs. / 29 kg		90	112 lbs. / 51 kg	
56	77 lbs. / 35 kg		125	154 lbs. / 70 kg	

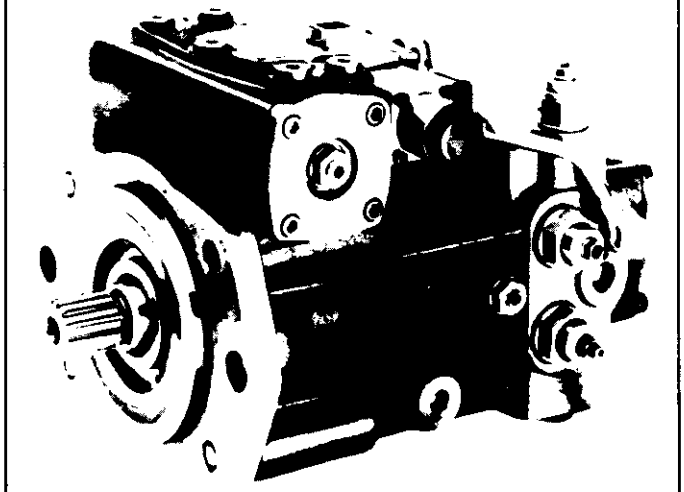
Note: See page 2 for spline data

Shaded dimensions are in millimeters.

Control Description

Proportional Electric Control, Type EL





The flow output of the pump is infinitely varied in the range of 0 to 100%, proportional to an electrical current, in the range of 200 ± 10% to 600 ± 10% milliamps at 24 volts dc, supplied to solenoid a or b. (A current of 400 ± 10% to 1200 ± 10% mA is required for the 12 volt solenoids)

The electrical energy is converted to a force acting on the control spool. The spool then directs control oil in and out of the control cylinder to stroke the pump as required. A feedback lever, connected to the control piston, maintains the pump flow for any given current within the control range.

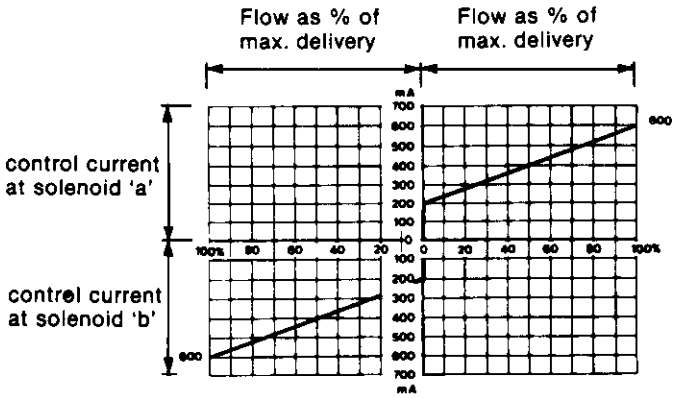
Even though this is a proportional control, the filtration requirement is the same as the total pump assembly.

A Rexroth amplifier, type 2014/2015 or 3004/3005, may be used to provide the control current to solenoid a or b. The amplifier requires an external power supply of 12 or 24 VDC and can be remotely operated by means of a panel or joystick mounted potentiometer. Refer to RA 95026 and RA 95027 for details of these amps.

Coil Resistance

Pump Size	Voltage	Ω @ 20 °C
40, 56, 90 & 125	12 VDC	6.2
	24 VDC	24.6

Coils require a 100 Hz. dither frequency with an amplitude of ± 300 mA for 12 volts dc or ± 150 mA for 24 volts dc.



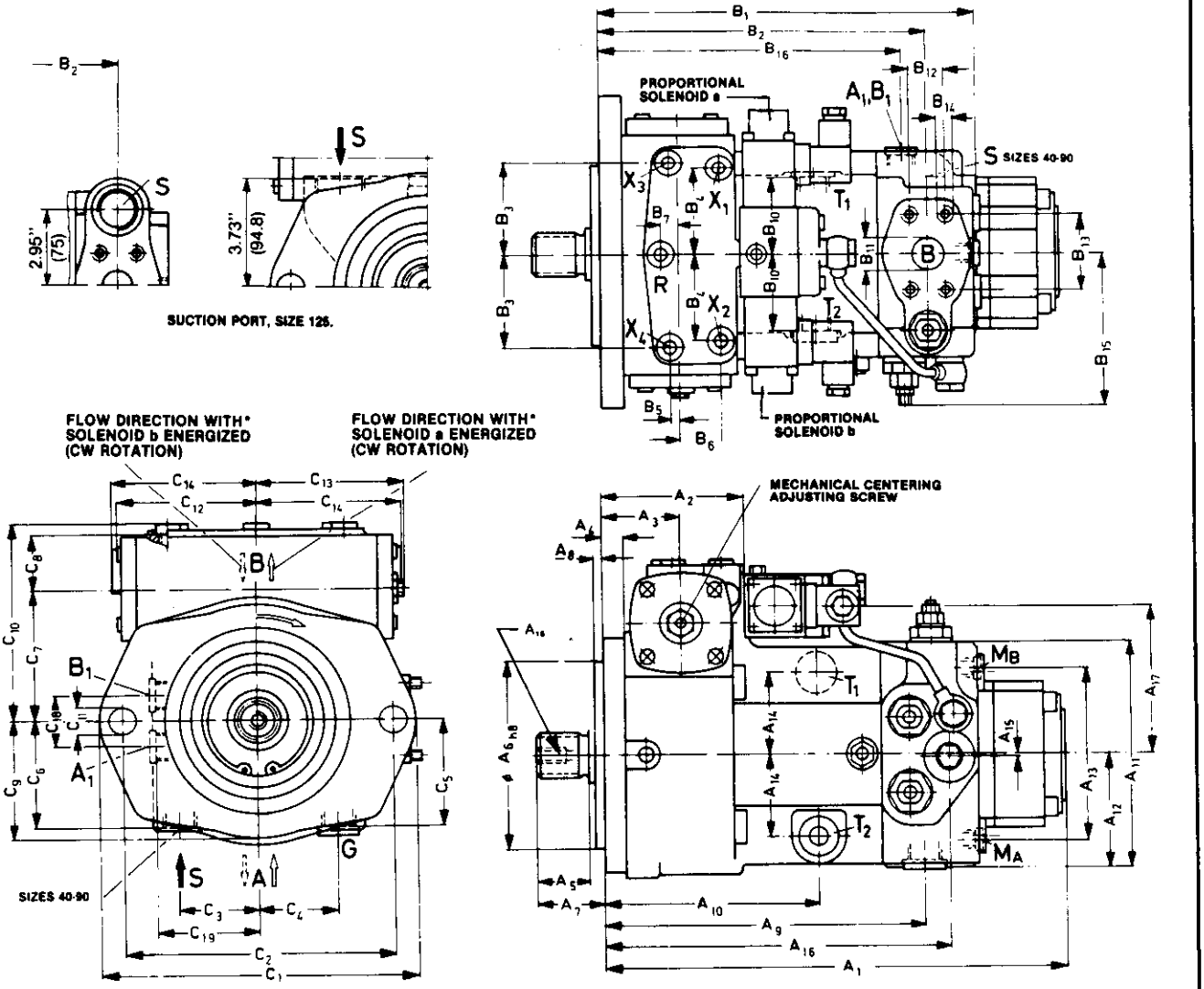
STANDARD STROKING TIMES		40	56	90	125
Zero to max. displ.	(sec)	1.0	1.0	1.2	1.2
Max. displ. to zero	(sec)	1.0	1.0	1.2	1.2

"Faster or slower stroking times are possible by changing the size of the stroking time orifices"

PORT DESIGNATIONS & SIZES		Size 40 & 56	Size 90	Size 125
A, B	— Service ports	SAE 3/4"-6000 psi	SAE 1"-6000 psi	SAE 1¼"-6000 psi
A_1, B_1	— Auxiliary service ports	3/4 "-16 UNF	3/4 "-16 UNF	3/4"-16 UNF
S	— Charge pump suction port	7/8 "-14 UNF	1-3/16"-12 UNF	1-5/8"-12 UNF
G	— Charge pump access port	7/8 "-14 UNF	1-1/16"-12 UNF	1-1/16"-12 UNF
T_1, T_2	— Case drain ports	7/8 "-14 UNF	1-1/16"-12 UNF	1-5/16"-12 UNF
M_A, M_B	— High pressure gage ports	7/16"-20 UNF	7/16"-20 UNF	7/16"-20 UNF
R	— Case vent port	7/16"-20 UNF	7/16"-20 UNF	7/16"-20 UNF
X_1, X_2	— Control pressure gage ports (before control orifices)	7/16"-20 UNF	7/16"-20 UNF	7/16"-20 UNF
X_3, X_4	— Control Pressure gage ports (after control orifices)	7/16"-20 UNF	7/16"-20 UNF	7/16"-20 UNF

Installation Dimensions

Pump Sizes 40, 56, 90 and 125 With EL Control



*Note: Flow direction is reversed with CCW rotation.

Size	A_1	A_2	A_3	A_4	A_5	A_6	A_7	A_8	A_9	A_{10}	A_{11}	A_{12}	A_{13}	A_{14}	A_{15}	A_{16}	A_{17}	A_{18}	B_1	B_2	B_3	B_4	B_5	B_6
40	11.22	3.31	1.81	0.51	1.89	5.00	2.20	0.49	7.82	5.00	5.39	2.70	4.57	1.85	—	8.51	3.54	7/16-14	9.30	8.00	2.20	2.05	0.30	0.96
	285	**84**	**46**	**13**	**48**	**127**	**56**	**12.5**	**198.6**	**127.1**	**137**	**68.5**	**116**	**47**	**—**	**216.1**	**89.8**	UNC-2B	**236.1**	**203.1**	**56**	**52**	**7.5**	**24.5**
56	12.05	3.67	2.05	0.59	1.89	5.00	2.20	0.49	8.41	5.60	5.98	2.99	4.57	2.15	—	9.10	3.88	7/16-14	9.89	8.59	2.44	2.28	0.18	1.08
	306	**93.3**	**52**	**15**	**48**	**127**	**56**	**12.5**	**213.7**	**142.2**	**152**	**76**	**116**	**54.5**	**—**	**231.2**	**98.5**	UNC-2B	**251.2**	**218.2**	**62**	**58**	**4.5**	**27.5**
90	13.39	4.21	2.28	0.67	1.89	6.00	2.20	0.49	9.65	6.57	6.50	3.25	5.12	2.32	—	10.33	4.43	7/16-14	11.30	9.69	2.83	2.68	0.02	1.24
	340	**107**	**58**	**17**	**48**	**152.4**	**56**	**12.5**	**245**	**167**	**165**	**82.5**	**130**	**59**	**—**	**262.5**	**112.5**	UNC-2B	**287**	**246**	**72**	**68**	**0.49**	**31.5**
125	15.37	4.76	2.58	0.79	2.64	6.00	2.93	0.49	10.73	7.19	7.48	3.74	5.91	2.60	0.16	11.59	4.86	5/8-11	12.70	10.73	3.15	2.95	—	1.40
	390.5	**121**	**65.5**	**20**	**67**	**152.4**	**74.5**	**12.5**	**272.5**	**182.5**	**190**	**95**	**150**	**66**	**4**	**294.5**	**123.5**	UNC-2B	**322.5**	**272.5**	**80**	**75**	**—**	**35.5**

Size	B_7	B_{10}	B_{11}	B_{12}	B_{13}	B_{14}	B_{15}	B_{16}	C_1	C_2	C_3	C_4	C_5	C_6	C_7	C_8	C_9	C_{10}	C_{11}	C_{12}	C_{13}	C_{18}	C_{19}
40	0.51	1.95	0.75	0.94	2.00	3/8-16 UNC	4.26	7.41	8.39	7.13	2.05	2.09	2.50	2.68	3.10	1.44	2.80	4.70	0.69	3.37	3.50	1.34	2.48
	13	**49.5**	**19**	**23.8**	**50.8**	**0.63 DEEP**	**108.2**	**188.1**	**213**	**181**	**52**	**53**	**63.5**	**68**	**78.8**	**36.5**	**71**	**119.3**	**17.5**	**85.6**	**89**	**34**	**63**
56	0.39	2.07	0.75	0.94	2.00	3/8-16 UNC	4.26	8.00	8.39	7.13	2.05	2.09	2.81	2.80	3.44	1.50	3.07	5.12	0.69	3.61	3.74	1.34	2.68
	10	**52.5**	**19**	**23.8**	**50.8**	**0.63 DEEP**	**108.2**	**203.2**	**213**	**181**	**52**	**53**	**71.5**	**71**	**87.5**	**38**	**78**	**130**	**17.5**	**91.6**	**95**	**34**	**68**
90	0.24	2.44	0.98	1.09	2.25	7/16-14 UNC	4.74	9.06	10.51	9.00	2.32	2.36	3.09	3.09	4.00	1.67	3.54	5.87	0.81	4.08	4.41	1.34	3.07
	6	**62**	**25**	**27.8**	**57.2**	**0.63 DEEP**	**120.5**	**230**	**267**	**228.6**	**59**	**60**	**78.5**	**78.5**	**101.5**	**42.5**	**90**	**149**	**20.6**	**103.6**	**112**	**34**	**78**
125	—	2.68	1.26	1.25	2.63	1/2-13 UNC	5.22	9.98	10.51	9.00	—	2.68	3.54	—	4.43	1.81	3.84	6.44	0.81	4.88	5.12	1.42	3.60
	—	**68**	**32**	**31.8**	**66.7**	**0.82 DEEP**	**132.5**	**253.5**	**267**	**228.6**	—	**68**	**90**	—	**112.5**	**46**	**97.5**	**163.5**	**20.6**	**124**	**130**	**36**	**91.5**

Weights:

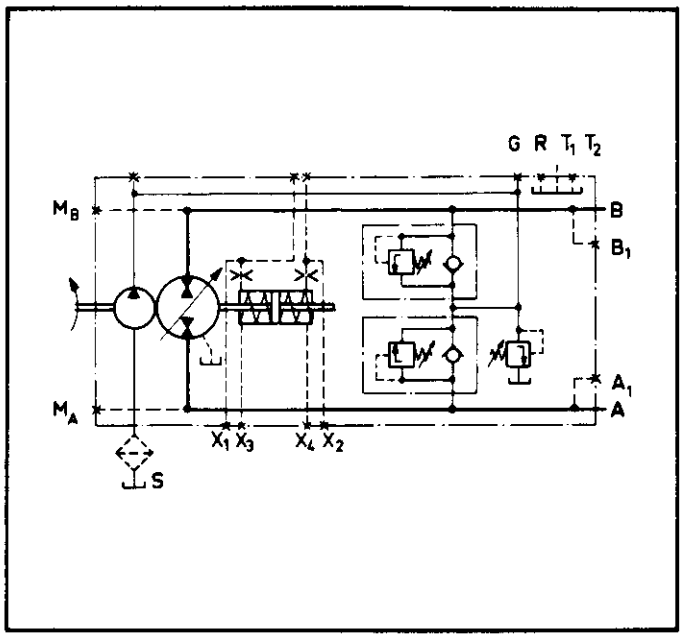
40	64 lbs. / 29 kg	90	112 lbs. / 51 kg
56	77 lbs. / 35 kg	125	154 lbs. / 70 kg

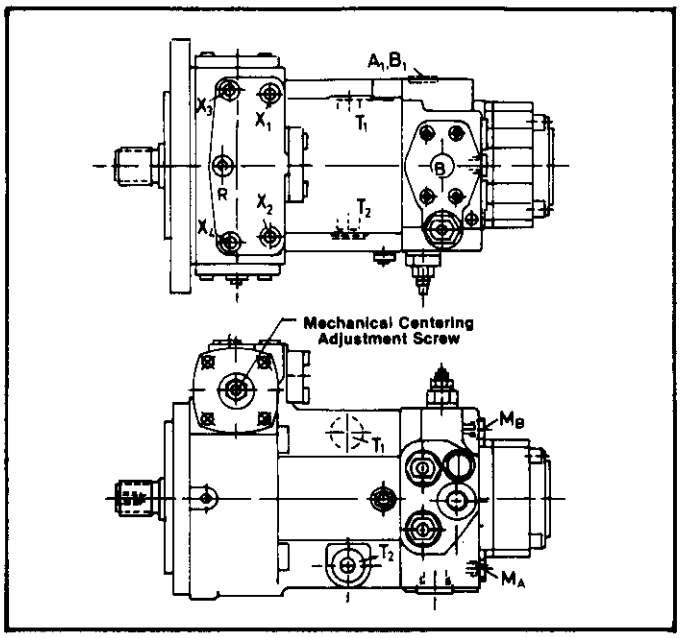
Note: See page 2 for spline data

Shaded dimensions are in millimeters.

Control Description

Pump Without Control Module, Type OV





CONTROL DESCRIPTION

Pumps with ordering code OV have no control module. The module is replaced by a cover plate.

When a hydraulic pressure, which is typically supplied by a remote hydraulic pilot control or pressure reducing valve, is applied to the X_1 or X_2 port, the pump will come on stroke to produce a flow of oil out of either the A or B port. Pump displacement is determined by the resistance of the centering springs in the pump, the hydraulic pressure supplied at port X_1 or X_2, and the hydrostatic centering force of the rotary group which is proportional to system pressure. This pump control is not a positive displacement control, since there is no control module.

Typical applications for an OV control are: a drive transmission in a vehicle where speed is continuously controlled by the operator and smooth acceleration and deceleration is a necessity or for a swing control on a crane or excavator. Some examples of these applications are skidsteer loaders, industrial sweepers, municipal sweepers, railroad equipment, tow tractors, and liftrucks.

CONTROL CHARACTERISTICS

1. Control piston displacement from neutral to maximum swash angle of 15° in either direction.

Pump Size	40	56	90	125
Displacement in³	0.685	0.987	1.585	2.227
(cm³)	(11.23)	(16.18)	(25.97)	(36.5)

2. Standard stroking times when using ports X_1 and X_2

Pump Size	40	56	90	125
Neutral to 15° swash angle	1.0	1.0	1.2	1.2
15° swash angle to neutral	1.0	1.0	1.2	1.2

Faster, or slower stroking times are possible by changing the size of the stroking time orifices in ports X_1 and X_2.

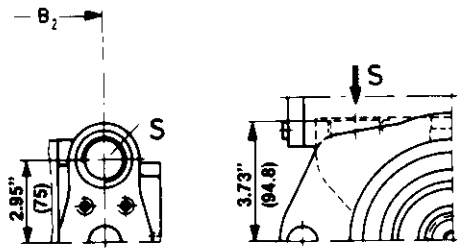
3. Control pressure at port X_3 or X_4 to begin stroking the pump against the centering springs with only charge pressure at port A and B = 87 psi (6 bar).
4. Control pressure required at port X_3 or X_4 to fully stroke the pump against the centering springs and hydrostatic centering forces at 5800 psi (400 bar) = 350 psi (24 bar).

NOTE: The pump swash angle, for any given control pressure between 87 psi (6 bar) and 350 psi (24 bar), will be influenced by changes in system pressure at port A or B.

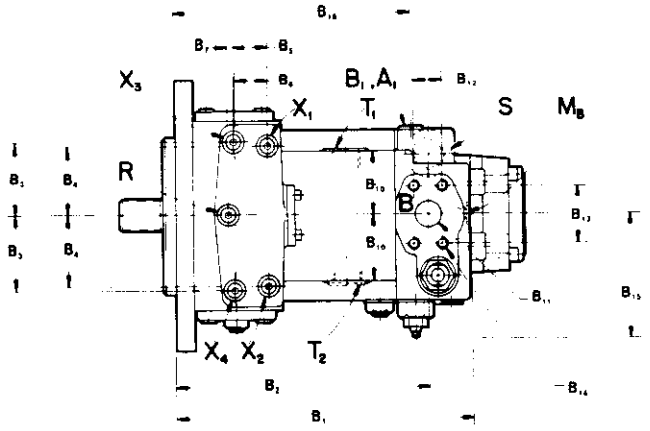
PORT DESIGNATIONS & SIZES		Size 40 & 56	Size 90	Size 125
A, B	— Service ports	SAE 3/4"-6000 psi	SAE 1"-6000 psi	SAE 1¼"-6000 psi
A_1, B_1	— Auxiliary service ports	3/4 "-16 UNF	3/4 "-16 UNF	3/4"-16 UNF
S	— Charge pump suction port	7/8 "-14 UNF	1-3/16"-12 UNF	1-5/8"-12 UNF
G	— Charge pump access port	7/8 "-14 UNF	1-1/16"-12 UNF	1-1/16"-12 UNF
T_1, T_2	— Case drain ports	7/8 "-14 UNF	1-1/16"-12 UNF	1-5/16"-12 UNF
M_A, M_B	— High pressure gage ports	7/16"-20 UNF	7/16"-20 UNF	7/16"-20 UNF
R	— Case vent port	7/16"-20 UNF	7/16"-20 UNF	7/16"-20 UNF
X_1, X_2	— Control pressure gage ports (before control orifices)	7/16"-20 UNF	7/16"-20 UNF	7/16"-20 UNF
X_3, X_4	— Control Pressure gage ports (after control orifices)	7/16"-20 UNF	7/16"-20 UNF	7/16"-20 UNF

Installation Dimensions

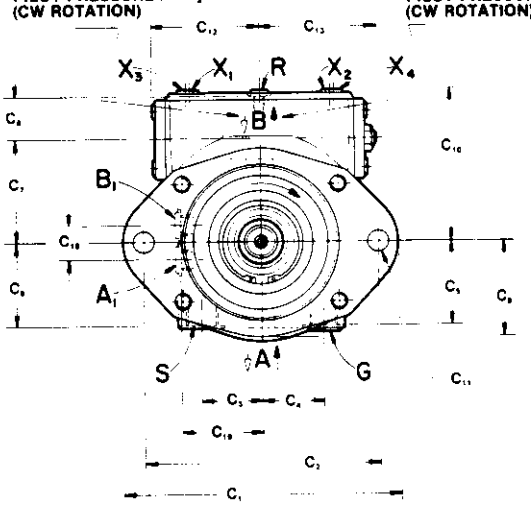
Pump Sizes 40, 56, 90 and 125 With OV Control



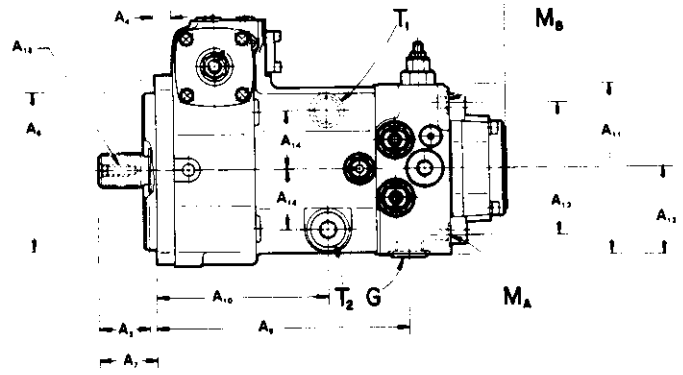
SUCTION PORT, SIZE 125.



FLOW DIRECTION WITH* PILOT PRESSURE AT X_2 (CW ROTATION)



FLOW DIRECTION WITH* PILOT PRESSURE AT X_1 (CW ROTATION)



*Note: Flow direction is reversed with CCW rotation.

Size	A_1	A_2	A_3	A_4	A_5	A_6	A_7	A_8	A_9	A_{10}	A_{11}	A_{12}	A_{13}	A_{14}	A_{15}	A_{16}	B_1	B_2	B_3	B_4	B_5	B_6	B_7
40	11.22	3.31	1.81	0.51	1.89	5.00	2.20	0.49	7.82	5.00	5.39	2.70	4.57	1.85	—	7/16-14	9.30	8.00	2.20	2.05	0.30	0.96	0.51
	285	**84**	**46**	**13**	**48**	**127**	**56**	**12.5**	**198.6**	**127.1**	**137**	**68.5**	**116**	**47**	**—**	UNC-2B	**236.1**	**203.1**	**56**	**52**	**7.5**	**24.5**	**13**
56	12.05	3.67	2.05	0.59	1.89	5.00	2.20	0.49	8.41	5.60	5.98	2.99	4.57	2.15	—	7/16-14	9.89	8.59	2.44	2.28	0.18	1.08	0.39
	306	**93.3**	**52**	**15**	**48**	**127**	**56**	**12.5**	**213.7**	**142.2**	**152**	**76**	**116**	**54.5**	**—**	UNC-2B	**251.2**	**218.2**	**62**	**58**	**4.5**	**27.5**	**10**
90	13.39	4.21	2.28	0.67	1.89	6.00	2.20	0.49	9.65	6.57	6.50	3.25	5.12	2.32	—	7/16-14	11.30	9.69	2.83	2.68	0.02	1.24	0.24
	340	**107**	**58**	**17**	**48**	**152.4**	**56**	**12.5**	**245**	**167**	**165**	**82.5**	**130**	**59**	**—**	UNC-2B	**287**	**246**	**72**	**68**	**0.5**	**31.5**	**6**
125	15.37	4.76	2.58	0.79	2.64	6.00	2.93	0.49	10.73	7.19	7.48	3.74	5.91	2.60	0.16	5/8-11	12.70	10.73	3.15	2.95	—	1.40	—
	390.5	**121**	**65.5**	**20**	**67**	**152.4**	**74.5**	**12.5**	**272.5**	**182.5**	**190**	**95**	**150**	**66**	**4**	UNC-2B	**322.5**	**272.5**	**80**	**75**	**—**	**35.5**	**—**

Size	B_{10}	B_{11}	B_{12}	B_{13}	B_{14}	B_{15}	B_{16}	C_1	C_2	C_3	C_4	C_5	C_6	C_7	C_8	C_9	C_{10}	C_{11}	C_{12}	C_{13}	C_{14}	C_{15}
40	1.95	0.75	0.94	2.00	3/8-16 UNC	4.26	7.41	8.39	7.13	2.05	2.09	2.50	2.68	3.10	1.44	2.80	4.70	0.69	3.37	3.50	1.34	2.48
	49.5	**19**	**23.8**	**50.8**	**0.63 DEEP**	**108.2**	**188.1**	**213**	**181**	**52**	**53**	**63.5**	**68**	**78.8**	**36.5**	**71**	**119.3**	**17.5**	**85.6**	**89**	**34**	**63**
56	2.07	0.75	0.94	2.00	3/8-16 UNC	4.26	8.00	8.39	7.13	2.05	2.09	2.81	2.80	3.44	1.50	3.07	5.12	0.69	3.61	3.74	1.34	2.68
	52.5	**19**	**23.8**	**50.8**	**0.63 DEEP**	**108.2**	**203.2**	**213**	**181**	**52**	**53**	**71.5**	**71**	**87.5**	**38**	**78**	**130**	**17.5**	**91.6**	**95**	**34**	**68**
90	2.44	0.98	1.09	2.25	7/16-14 UNC	4.74	9.06	10.51	9.00	2.32	2.36	3.09	3.09	4.00	1.67	3.54	5.87	0.81	4.08	4.41	1.34	3.07
	62	**25**	**27.8**	**57.2**	**0.63 DEEP**	**120.5**	**230**	**267**	**228.6**	**59**	**60**	**78.5**	**78.5**	**101.5**	**42.5**	**90**	**149**	**20.6**	**103.6**	**112**	**34**	**78**
125	2.68	1.26	1.25	2.63	1/2-13 UNC	5.22	9.98	10.51	9.00	—	2.68	3.54	—	4.43	1.81	3.84	6.44	0.81	4.88	5.12	1.42	3.60
	68	**32**	**31.8**	**66.7**	**0.82 DEEP**	**132.5**	**253.5**	**267**	**228.6**	**—**	**68**	**90**	**—**	**112.5**	**46**	**97.5**	**163.5**	**20.6**	**124**	**130**	**36**	**91.5**

Weights:

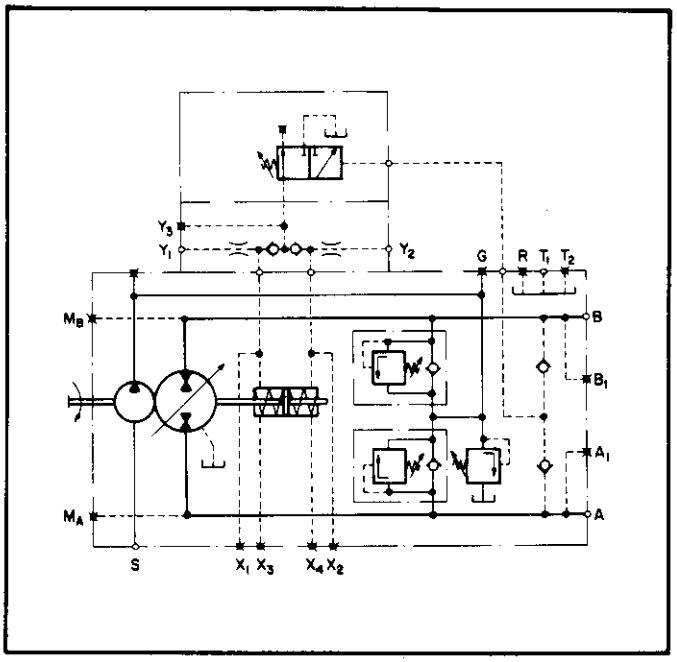
40	64 lbs. / 29 kg	90	112 lbs. / 51 kg
56	77 lbs. / 35 kg	125	154 lbs. / 70 kg

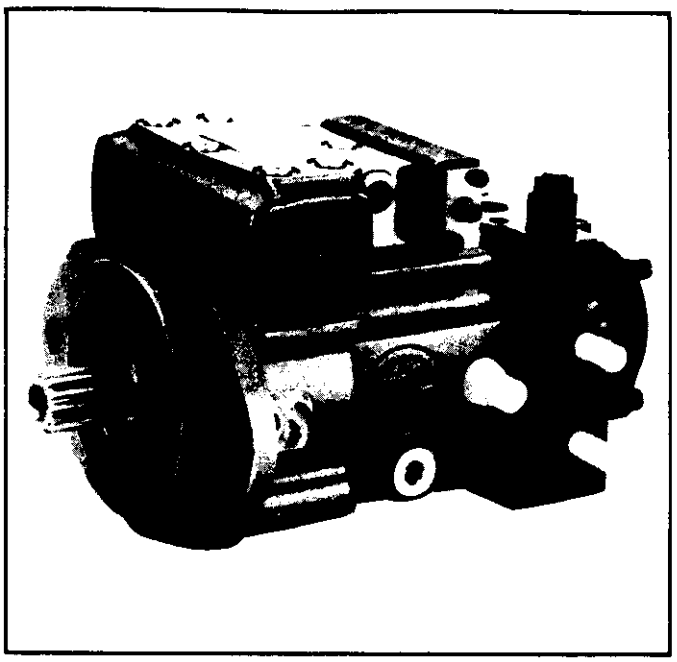
Note: See page 2 for spline data

Shaded dimensions are in millimeters.

Control Description

Pump Without Control Module With P.O.R. Type HM





CONTROL DESCRIPTION

The HM pump control provides the same type of displacement control as an OV, but also incorporates a pressure override valve. When a hydraulic pressure, which is typically supplied by a remote hydraulic pilot control or pressure reducing valve, is applied to the Y_1 or Y_2 port, the pump will come on stroke to produce a flow of oil out of either the A or B port. Pump displacement is determined by the resistance of the centering springs in the pump, the hydraulic pressure supplied at port Y_1 or Y_2 and the hydrostatic centering force of the rotary group which is proportional to system pressure. The pressure override valve (P.O.R.) varies the swashplate angle, as required, to limit the maximum system pressure at port A or B. The override valve prevents continuous dumping of excessive flow, at load pressure, through the cross port relief valves contained in the pump. This pump control is not a positive displacement control, since there is no feedback between the stroking piston and the control module.

Typical applications for an HM control are: a drive transmission in a vehicle where speed is continuously controlled by the operator and smooth acceleration and deceleration is a necessity or for a swing control on a crane or excavator. Some examples of these applications are skidsteer loaders, industrial sweepers, municipal sweepers, railroad equipment, tow tractors, and liftrucks.

CONTROL CHARACTERISTICS

1. Standard stroking times when using ports Y_1 and Y_2.

Pump Size	40	56	90	125
Neutral to 15° swash angle	1.0	1.0	1.2	1.2
15° swash angle to neutral	1.0	1.0	1.2	1.2

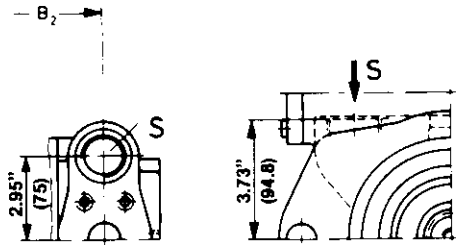
2. Control pressure required at port X_3 or X_4 to begin stroking the pump against the centering spring with only charge pressure at port A and B = 87 psi (6 bar).
3. Control pressure required at port X_3 to X_4 to fully stroke the pump against the centering springs and hydrostatic centering forces at 5800 psi (400 bar) = 350 psi (24 bar).

NOTE: The pump swash angle, for any given control pressure between 87 psi (6 bar) and 350 psi (24 bar), will be influenced by changes in system pressure at port A or B.

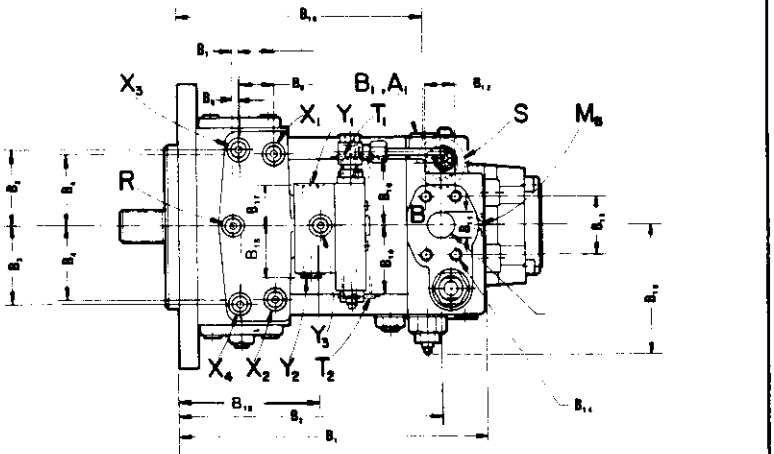
PORT DESIGNATIONS & SIZES		Size 40 & 56	Size 90	Size 125
A, B	— Service ports	SAE 3/4"-6000 psi	SAE 1"-6000 psi	SAE 1¼"-6000 psi
A_1, B_1	— Auxiliary service ports	3/4 "-16 UNF	3/4 "-16 UNF	3/4"-16 UNF
S	— Charge pump suction port	7/8 "-14 UNF	1-3/16"-12 UNF	1-5/8"-12 UNF
G	— Charge pump access port	7/8 "-14 UNF	1-1/16"-12 UNF	1-1/16"-12 UNF
T_1, T_2	— Case drain ports	7/8 "-14 UNF	1-1/16"-12 UNF	1-5/16"-12 UNF
M_A, M_B	— High pressure gage ports	7/16"-20 UNF	7/16"-20 UNF	7/16"-20 UNF
R	— Case vent port	7/16"-20 UNF	7/16"-20 UNF	7/16"-20 UNF
X_1, X_2	— Control pressure gage ports (before control orifices)	7/16"-20 UNF	7/16"-20 UNF	7/16"-20 UNF
X_3, X_4	— Control Pressure gage ports (after control orifices)	7/16"-20 UNF	7/16"-20 UNF	7/16"-20 UNF
Y_1, Y_2	— Pilot pressure ports	9/16"-18 UNF	9/16"-18 UNF	9/16"-18 UNF

Installation Dimensions

Pump Sizes 40, 56, 90 and 125 With HM Control

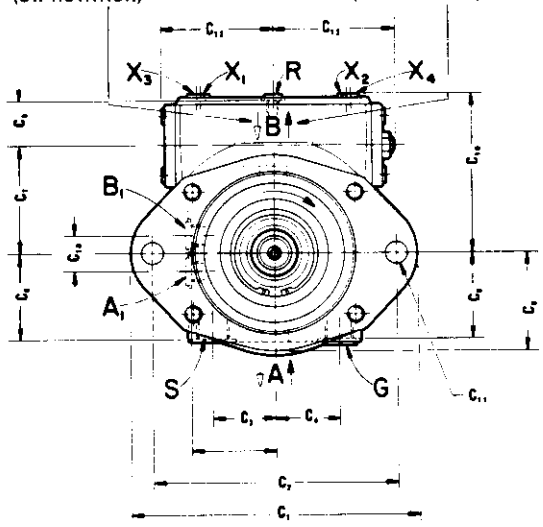


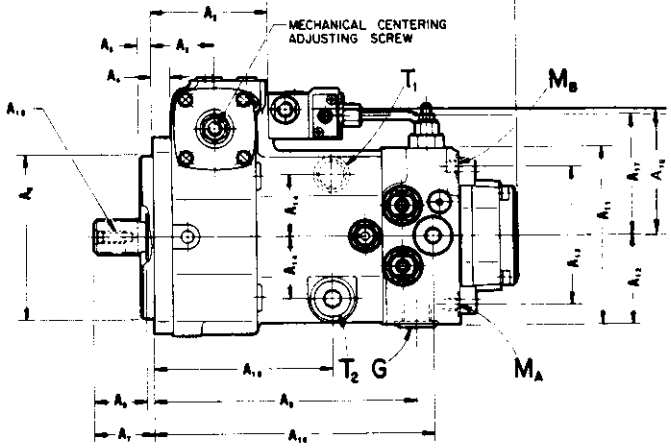
SUCTION PORT, SIZE 125.



FLOW DIRECTION WITH* PILOT PRESSURE AT Y2 (CW ROTATION)

FLOW DIRECTION WITH* PILOT PRESSURE AT Y1 (CW ROTATION)





*Note: Flow direction is reversed with CCW rotation.

Size	A_1	A_2	A_3	A_4	A_5	A_6	A_7	A_8	A_9	A_{10}	A_{11}	A_{12}	A_{13}	A_{14}	A_{15}	A_{16}	A_{17}	A_{18}	A_{19}	B_8	B_9	B_{10}	B_{11}	B_{12}
40	11.22	3.31	1.81	0.51	1.89	5.00	2.20	0.49	7.82	5.00	5.39	2.70	4.57	1.85	—	8.51	3.54	7/16-14	3.80	4.07	2.58	1.95	0.75	0.94
	285	84	46	13	48	127	56	12.5	198.6	127.1	137	68.5	116	47	—	216.1	89.8	UNC-2B	96.5	103.4	65.5	49.5	19	23.8
56	12.05	3.67	2.05	0.59	1.89	5.00	2.20	0.49	8.41	5.60	5.98	2.99	4.57	2.15	—	9.10	3.88	7/16-14	4.14	4.44	2.58	2.07	0.75	0.94
	306	93.3	52	15	48	127	56	12.5	213.7	142.2	152	76	116	54.5	—	231.2	98.5	UNC-2B	105.2	112.7	65.5	52.5	19	23.8
90	13.39	4.21	2.28	0.67	1.89	6.00	2.20	0.49	9.65	6.57	6.50	3.25	5.12	2.32	—	10.33	4.43	7/16-14	4.69	4.98	2.58	2.44	0.98	1.09
	340	107	58	17	48	152.4	56	12.5	245	167	165	82.5	130	59	—	262.5	112.5	UNC-2B	119.1	126.4	65.5	62	25	27.8
125	15.37	4.76	2.58	0.79	2.64	6.00	2.93	0.49	10.73	7.19	7.48	3.74	5.91	2.60	0.16	11.59	4.86	5/8-11	5.12	5.53	2.58	2.68	1.26	1.25
	390.5	121	65.5	20	67	152.4	74.5	12.5	272.5	182.5	190	95	150	66	4	294.5	123.5	UNC-2B	130.0	140.4	65.5	68	32	31.8

Size	B_{13}	B_{14}	B_{15}	B_{16}	B_{17}	B_{18}	B_{19}	C_1	C_2	C_3	C_4	C_5	C_6	C_7	C_8	C_9	C_{10}	C_{11}	C_{12}	C_{13}	C_{18}	C_{19}
40	2.00	3/8-16 UNC	4.26	7.41	1.54	1.97	4.05	8.39	7.13	2.05	2.09	2.50	2.68	3.10	1.44	2.80	4.70	0.69	3.37	3.50	1.34	2.48
	50.8	0.63 DEEP	108.2	188.1	39.1	50.0	102.9	213	181	52	53	63.5	68	78.8	36.5	71	119.3	17.5	85.6	89	34	63
56	2.00	3/8-16 UNC	4.26	8.00	1.54	1.97	4.39	8.39	7.13	2.05	2.09	2.81	2.80	3.44	1.50	3.07	5.12	0.69	3.61	3.74	1.34	2.68
	50.8	0.63 DEEP	108.2	203.2	39.1	50.0	111.5	213	181	52	53	71.5	71	87.5	38	78	130	17.5	91.6	95	34	68
90	2.25	7/16-14 UNC	4.74	9.06	1.54	1.97	4.94	10.51	9.00	2.32	2.36	3.09	3.09	4.00	1.67	3.54	5.87	0.81	4.08	4.41	1.34	3.07
	57.2	0.63 DEEP	120.5	230	39.1	50.0	125.5	267	228.6	59	60	78.5	78.5	101.5	42.5	90	149	20.6	103.6	112	34	78
125	2.63	1/2-13 UNC	5.22	9.98	1.54	1.97	5.37	10.51	9.00	—	2.68	3.54	—	4.43	1.81	3.84	6.44	0.81	4.88	5.12	1.42	3.60
	66.7	0.82 DEEP	132.5	253.5	39.1	50.0	136.4	267	228.6	—	68	90	—	112.5	46	97.5	163.5	20.6	124	130	36	91.5

Weights:

40	64 lbs. / 29 kg	90	112 lbs. / 51 kg
56	77 lbs. / 35 kg	125	154 lbs. / 70 kg

Note: See page 2 for spline data

Shaded dimensions are in millimeters.

Optional Features

Through Drive for Auxiliary Pump

- Standard SAE A, B, B-B, and C 2 bolt mounting flanges
- Convenient location for additional pump
- Compact Dimensions
- Rexroth steering pumps can be mounted to provide complete drive and steering package
- Through drive can be retrofitted in the field

Length of through drive adapter: ("b" dimension)

Through drive	Size	40	56	90	125
SAE A (Code C)		1.99	2.24	2.17	3.31
SAE B (Code G)		3.76	4.02	3.94	2.83
SAE B-B (Code J)		3.76	4.02	3.94	3.07
SAE C (Code M)				4.96	5.24

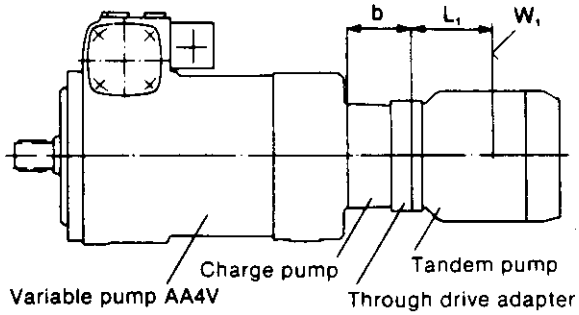
Maximum Allowable Through Drive Torque: T_{max} (lb-ft)

Through drive	Size	40	56	90	125
SAE A (Code C)		74	74	74	74
SAE B (Code G)		118	118	118	162
SAE B-B (Code J)		118	118	118	244
SAE C (Code M)				162	162

Refer to RA06204 for more information.

Charge Pump and Through Drive

Allowable moment of force (M_{max})
Allowable through drive torque (T_{max})



L_1 (inches) Distance to center of gravity of tandem pump.

b (inches) Length of through drive adapter.

W_1 (pounds) Weight of tandem pump.

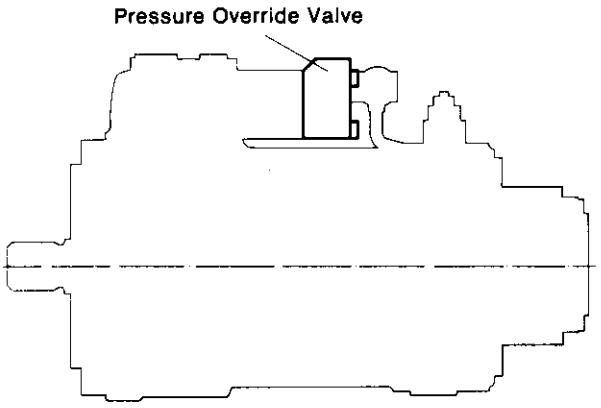
$$M = W_1 . (L_1 + b) . \frac{1}{12} \text{ (lb-ft.)}$$

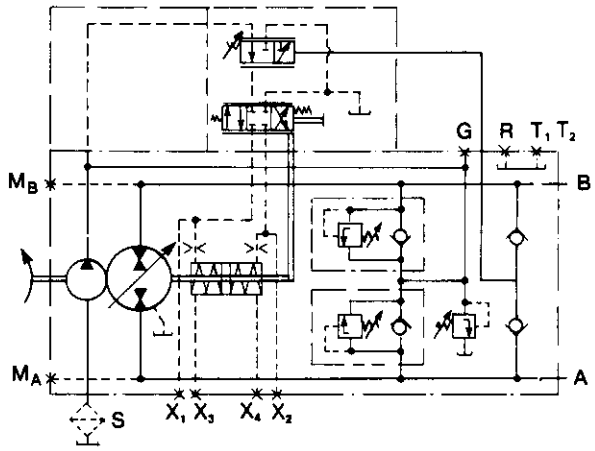
Allowable Moment of Force: M_{max} (lb-ft)

Through drive	Size	40	56	90	125
SAE A (Code C)		38	38	38	76
SAE B (Code G)		37	37	37	76
SAE B-B (Code J)		37	37	37	76
SAE C (Code M)				162	120

Pressure Override

With porting for a pressure override valve (P.O.R.). The pressure override valve varies the swashplate angle, as required, to limit the maximum pressure at port A or B. The override valve prevents continuous dumping of excessive flow, at load pressure, through the cross port relief valves contained in the pump. This eliminates unnecessary heating of the oil and protects the pump and motor from heavy-handed operators, or, if the drive stalls causing the pump to deadhead. The pressure override valve should be adjusted to a pressure 500 psi (34 bar) less than the setting of the main relief valves and has an adjustment range of 1160-6100 psi (80-920 bar).





Variable pump AA4V with hydraulic manual servo control, HW with pressure override valve (P.O.R.)

CIRCUIT SCHEMATIC, OPTION NUMBER 1

Optional Features

FILTRATION

The fluid should be filtered prior to system start-up, and continuously during operation, to achieve and maintain a cleanliness level of ISO 18/15. (This corresponds approximately to NAS 1638 Class 9, or SAE [1963] Class 6.) This recommendation should be considered a minimum, as better cleanliness levels will significantly increase component life.

Each application should be analyzed to determine the proper method of filtration needed to maintain the required cleanliness levels, as contaminant generation and ingression can vary greatly, depending on the configuration and complexity of the system.

For particular system requirements, or for application outside these parameters, a Rexroth Applications Engineer should be consulted.

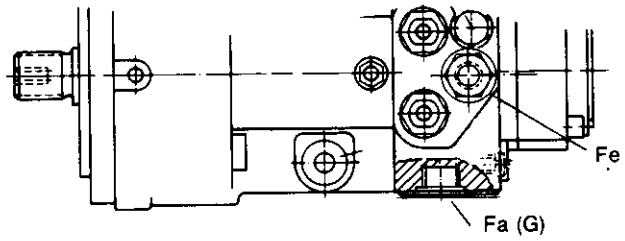
FILTER PORT OPTIONS

Ordering Code Option Number 1
Suction Filter

Fluid cleanliness level ..... ISO code 18/15
Pressure drop at filter element
at V = 141 SSU (30 cSt) and pump max speed ..... 1.5 psi (0.1 bar)
at V = 4600 SSU (1000 cSt) and 1000 rpm ..... 4.4 psi (0.3 bar)
Pressure at inlet port of charge pump
at V = 141 SSU (30 cSt) ..... – 3 psig (0.8 bar)
on cold start ..... – 7 psig (0.5 bar)

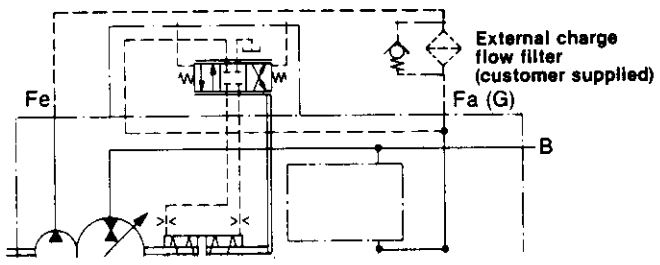
A suction filter without bypass and with clogging indicator is recommended.

Ordering Code Option Number 2*
With porting for external charge flow filter, this option is achieved by removing the plug in port Fe and replacing it with an adapter sleeve. This adapter sleeve allows all of the fluid from the charge pump to be passed through a customer supplied, external, low pressure filter prior to being delivered into the closed loop circuit via port Fe (G).



Filter Connection Port Sizes

Pump Size	40 & 56	90	125
Port Fe	7/8"-14 UNF	7/8"-14 UNF	1-1/16"-12 UNF
Port Fa (G)	7/8"-14 UNF	1-1/16"-12 UNF	1-1/16"-12 UNF



CIRCUIT SCHEMATIC, OPTION NUMBER 2

External Charge Flow Filter

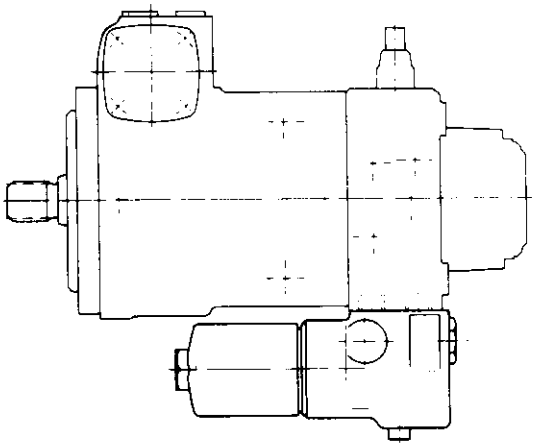
Fluid cleanliness level ..... ISO code 18/15
Pressure drop at filter element
at V = 141 SSU (30 cSt) ..... 14.5 psi (1.0 bar)
on cold start ..... 45 psi (3 bar)
(Valid for speed range Nmin. to Nmax.)

A charge flow filter with bypass and with clogging indicator is recommended. FILTER ELEMENT MUST BE CAPABLE OF WITHSTANDING FULL CHARGE PRESSURE WITHOUT COLLAPSING.

IMPORTANT
Never plug port Fe, when the adapter sleeve is fitted as there will be no internal pressure protection for the charge pump. The charge flow filter should include a by-pass check valve.

Ordering Code Option Number 5
Filter in charge pressure loop of AA4V. Filter direct mounted to AA4V pump.

Contact Rexroth for details and availability of this option.



AA4V series 1 with direct mounted filter

***NOTE** Ordering code option 2 is not available on pumps fitted with the Speed Sensing Horsepower Limiter. If option 2 is required along with horsepower limiting, an external limiting valve is needed.

Notes:

Specifications, descriptions and illustrative material shown herein were as accurate as known at the time this publication was approved for printing. Rexroth reserves the right to discontinue models or options at any time or to change specifications, materials, or designs without notice and without incurring obligation.

Optional equipment and accessories may add cost to the basic unit, and some options are available only in combination with certain models or other options. For the available combinations refer to the relevant data sheets for the basic unit and the desired option.

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