Open Circuit
Axial Piston Pumps
Technical Information
Open Circuit Pumps

Design Features

- Variable Displacement, Axial Piston Pumps
- Multiple Control Options
- Proven Mobile and Industrial Applications
- Two Versions Available: "Quiet (Mobile)" and "Super Quiet" (Industrial)
- Operating Pressures to 3000 PSI (210 BAR)
- Drive Speeds to 3600 RPM
- Atmospheric Inlet
- Worldwide Service
Proven Components

All Sauer-Sundstrand Series L variable displacement, axial piston pumps use the same basic materials, processes, and design of piston/slipper and cylinder block that have already been field proven in numerous closed circuit applications. The replacement valve plate is made of steel or steel backed bronze which offers a superior bearing surface. The rugged composition of the valve plate reduces repair costs and decreases susceptibility to lubrication failures.

Series L pumps feature standard SAE mounting flanges with continuous pilot diameters. This allows direct mounting on surfaces that need to be sealed with a gasket or O-ring.

Precise Control

The pump will always deliver a volume of fluid in proportion to the angle of the swashplate at any given input speed. Varying the swashplate angle provides a means of varying the pump flow. During normal operation, the swashplate angle varies from its maximum displacement position to the minimum “deadhead” position. The standard flow adjusting screw enables the maximum pump delivery to be externally adjusted to match precise system flow requirements.

The speed of the actuator (cylinder, motor, etc.) used in the system depends on the volume of fluid being pumped, while the load on the actuator determines the operating pressure. If the actuator is to be reversed, a directional control valve is necessary since the pump swashplate operates on one side of center only.
Two Versions Available

Two versions of the Series L pumps are available:

- **Series L "Quiet"**
  These cost efficient pumps are recommended for mobile applications such as pavers, man lifts, and light duty agricultural equipment.

- **Series L "Super-Quiet"**
  Specifically designed for the noise-critical application, the Series L pumps are available in a Super-Quiet version.

  Depending on operating parameters, noise levels are up to 6 dbA lower.

  By utilizing the appropriate automatic and energy saving controls, the Series L "Super-Quiet" pump is an efficient means of operating industrial machines. Lathes, boring and milling equipment, pipe cutters, and other process and shaping machinery can be fully powered while keeping noise levels to a minimum.

Options For Any Application

A vast array of options allows each of the Series L units to be easily matched to any application.

A choice of clockwise or counterclockwise input shaft rotation is available on all Series L units. SAE splined and straight keyed shafts are available as well as auxiliary mounting pads on certain models.

Optional side or end porting allows the Series L units to further adapt to any mounting position. Pump drive may be direct from the prime mover, or indirect using belt, chain, or gear drive.

Series L units are available for use with high-water-content and other fire resistant fluids. Contact your Sauer-Sundstrand sales representative for details.

The selection of field proven controls allows you to match the proper control function to the application. Benefits include circuit simplification as well as potential energy savings.

Worldwide Sales and Service

Sauer-Sundstrand sales and service representatives are located worldwide in major industrial trade areas to provide experienced application assistance and prompt delivery of "standardized" models to meet your hydraulic system needs.
## Variable Displacement Pumps

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<td>in. Hg</td>
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</table>

**NOTE:** Positive inlet pressure is required at maximum pump speeds.
The following equations are typically used when selecting a pump for a particular application. Sauer-Sundstrand Application Engineering can assist in sizing components for your application.

**Terminology**

- **D**: Displacement (cu. in./rev.)
- **P**: Fluid Pressure (PSI)
- **Q**: Flow Rate (GPM)
- **N**: Shaft Rotational Speed (RPM)
- **T**: Shaft Torque (lb. in.)
- **d**: Hydraulic Line I.D. (in.)
- **t**: Hydraulic Line Wall Thickness (in.)
- **S**: Material Stress (PSI)
- **e_v**: Volumetric Efficiency (%)
- **e_t**: Torque Efficiency (%)
- **e_o**: Overall Efficiency (%)

**Horsepower**

\[ \text{Fluid HP} = \frac{QP}{1714} \]

\[ \text{Mechanical HP} = \frac{TN}{63025} \]

**Theoretical Power Conversions**

\[ Q = \frac{DN}{231} \]

(Translated by volumetric efficiency for real case)

\[ T = \frac{DP}{2\pi} \]

(Translated by torque efficiency for real case)

**Power Conversions With Efficiencies**

Volumetric Efficiency (e_v)

\[ Q = \frac{DN \cdot e_v}{231} \quad (1/100) \]

or

\[ e_v = \frac{231 \cdot Q}{DN} \quad (100) \]

Torque Efficiency (e_t)

\[ T = \frac{DP}{2\pi \cdot e_t} \quad (1/100) \]

or

\[ e_t = \frac{DP}{2\pi \cdot T} \quad (100) \]
Power Conversions With Efficiencies (cont.)

Overall Efficiency

\[
\eta_0 = \frac{\text{Mech HP}}{\text{Fluid HP}}
\]  (100)

\[
\eta_0 = \left(\frac{\text{TN}}{\text{QP}}\right) \frac{1714}{63025}
\]  (100)

or

\[
\eta_0 = \left(\frac{\eta_v}{100}\right) \left(\frac{\eta_l}{100}\right)
\]

Sizing Hydraulic Line I.D.

For Pressure Lines, Fluid Velocity = 15 feet/sec. maximum.

\[Q = 2.45 \times 10^{-2} \times d^2\]

\[d = \left(\frac{Q}{1.2}\right)^{1/2} \div 6.06\]

For Suction Lines, Fluid Velocity = 6 feet/sec. maximum

\[d = \left(\frac{Q}{1.2}\right)^{1/2} \div 3.83\]

Sizing Line Wall Thickness

\[t = \frac{d}{2} \left[\frac{\sqrt{S+P}}{\sqrt{S-P}} - 1\right]\]

Note: Working stress for steel hydraulic tubing is normally about 14,000 PSI.

Conversion Factors

Cubic Centimeters = Cubic Inches x 16.39
Cubic Inches = Cubic Centimeters x 0.06102
Cubic Feet = Gallons x 0.1337
Liters = Gallons x 3.785
Kilowatts = Horsepower x .7457
Kilograms/Sq. Cm. = Pounds/Sq. In. x 0.0703
Degrees/Second = Revolutions/Minute x 6.0
Centimeters = Inches x 2.54
Millimeters = Inches x 25.4
BAR = PSI x 0.06897
Newton Meters = Pounds Feet x 0.737
Frame Size 15 - Variable Displacement Pump Specifications

DELIVERY AT MAX. RPM 14 GPM (53 l/min)
MIN INLET PRESSURE 5" Hg Vacuum
(0.8 BAR abs.)
FILTRATION
  • Inlet 150 Mesh
  • Return Line 25 Micron
CASE PRESSURE 10 PSI (0.7 BAR) Max.
FLUID TEMPERATURE
  180°F (82°C) Continuous
  200°F (93°C) Intermittent*
MOUNTING FLANGE SAE "A"
SHAFT OPTIONS SAE "A" spline or
  Straight Keyed
WEIGHT
  • Flange Mounted 25 lbs. (11.5 kg)
BEARING B-10 LIFE**
  • 1000 PSI (70 BAR) 130,000 Hrs.
  • 2000 PSI (140 BAR) 16,300 Hrs.
  • 3000 PSI (210 BAR) 4800 Hrs.

* Not to exceed 5 minutes
** Based on operation at 1800 RPM and maximum swashplate angle.

Performance Characteristics
L-15 Open Circuit Pump

Outlet Flow - GPM

Inlet Pressure vs. Speed

Swashplate Angle vs. Shaft Speed

Input Horsepower

Noise Levels - db(a)
Measured 3.3 ft. (1 m) from pump - 1800 RPM

QUIET L-15

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<tr>
<th>Pressure - PSI</th>
<th>0</th>
<th>500</th>
<th>1000</th>
<th>1500</th>
<th>2000</th>
<th>2500</th>
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<td>71</td>
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<td>76</td>
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<td>72</td>
<td>73</td>
<td>74</td>
<td>75.5</td>
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SUPER QUIET L-15

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<th>1000</th>
<th>1500</th>
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<td>64</td>
<td>68</td>
<td>68</td>
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<td>60</td>
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<td>65</td>
<td>67</td>
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Note: Performance curves based on 120°F oil temperature and ISO VG46 oil, and are representative of this series size.
Frame Size 23 - Variable Displacement Pump Specifications

DELIVERY AT MAX. RPM 19.5 GPM (73.8 l/min)
MIN INLET PRESSURE 5° Hg Vacuum
(0.8 BAR abs.)

FILTRATION
• Inlet 150 Mesh
• Return Line 25 Micron

CASE PRESSURE 10 PSI (0.7 BAR) Max.

FLUID TEMPERATURE
180°F (82°C) Continuous
200°F (93°C) Intermittent

MOUNTING FLANGE SAE "B"
SHAFT OPTIONS SAE "B" spline or Straight Keyed

WEIGHT
• Flange Mounted 40 lbs. (18.0 kg)

BEARING B-10 LIFE**
• 1000 PSI (70 BAR) 100,000 Hrs.
• 2000 PSI (140 BAR) 33,600 Hrs.
• 3000 PSI (210 BAR) 8700 Hrs.

* Not to exceed 5 minutes
** Based on operation at 1800 RPM and maximum swashplate angle.

Performance Characteristics L-23 Open Circuit Pump

Outlet Flow - GPM

Inlet Pressure vs. Speed

Swashplate Angle vs. Shaft Speed

Input Horsepower

Noise Levels - db(a)
Measured 3.3 ft. (1 m) from pump - 1800 RPM

QUIET L-23
Pressure - PSI 0 500 1000 1500 2000 2500 3000
Full Flow 69 71 73 74 76 78 79
Dead Head -- 68 69 70 72 73 75

SUPER QUIET L-23
Pressure - PSI 0 500 1000 1500 2000 2500 3000
Full Flow 62 64 66 68 69 70 71
Dead Head -- 58 61 64 66 67 68

Note: Performance curves based on 120°F oil temperature and ISO VG46 oil, and are representative of this series size.
Frame Size 23 - Variable Displacement Pump Installation Drawings

DELIVERY ADJUSTMENT SCREW (ONE TURN CHANGES MAX DISPLACEMENT BY 0.125 in³/REV (2.02 cc/REV))

DRAIN CONNECTION 1/8-18UN-2B SAE STRAIGHT THD "O" RING BOSS

CONTROL LOCATION FOR CW ROTATION
CONTROL LOCATION FOR CCW ROTATION

End Cap Porting

SIDE PORTING (X) 1/8-12UNF-2B SAE STRAIGHT THD "O" RING BOSS
END PORTING (Y) 3/8-12UNF-2B SAE STRAIGHT THD "O" RING BOSS

Direction | Rotation | Ports
---------|----------|-------
CW       | A        | B
CCW      | B        | A

Volumetric Efficiency - Percent

Overall Efficiency - Percent
Frame Size 38 - Variable Displacement Pump Specifications

DELIVERY AT MAX. RPM 29.8 GPM (113 l/min)
MIN INLET PRESSURE 5" Hg Vacuum (0.8 BAR abs.)

Filtration
- Inlet: 150 Mesh
- Return Line: 25 Micron

CASE PRESSURE 10 PSI (0.7 BAR) Max.

FLUID TEMPERATURE
- 180°F (82°C) Continuous
- 200°F (93°C) Intermittent

MOUNTING FLANGE SAE "B"

SHAFT OPTIONS SAE "B" spline (std or long)
or Straight Keyed

AUXILIARY PAD OPTION SAE "A"

WEIGHT
- Flange Mounted: 48 lbs. (22.0 kg)

BEARING B-10 LIFE**
- 1000 PSI (70 BAR) 62,600 Hrs.
- 2000 PSI (140 BAR) 6200 Hrs.
- 3000 PSI (210 BAR) 1600 Hrs.

* Not to exceed 5 minutes
** Based on operation at 1800 RPM and maximum swashplate angle.

Performance Characteristics
L-38 Open Circuit Pump

Output Flow - GPM

Inlet Pressure vs. Speed

Swashplate Angle vs. Shaft Speed

Input Horsepower

Noise Levels - db(a)
Measured 3.3 ft. (1 m) from pump - 1800 RPM

QUIET L-38
Pressure - PSI
Full Flow 73.5 73.5 74.5 76 77 77.5 80
Dead Head -- 71 73 73.5 75 77 79

SUPER QUIET L-38
Pressure - PSI
Full Flow 64 65.5 67 69 71 73 75
Dead Head -- 60 62 64 66 68 70.5

Note: Performance curves based on 120°F oil temperature and ISO VG46 oil, and are representative of this series size.
Frame Size 38 - Variable Displacement Pump Installation Drawings

End Cap Porting

SAE Spline Shaft

Volumetric Efficiency - Percent

Overall Efficiency - Percent
Frame Size 50 - Variable Displacement Pump Installation Drawings

DELIVERY AT MAX. RPM 32.7 GPM (124 l/min)
MIN INLET PRESSURE 5" Hg Vacuum
(0.8 BAR abs.)

Filtration
- Inlet 150 Mesh
- Return Line 25 Micron

CASE PRESSURE 10 PSI (0.7 BAR) Max.

FLUID TEMPERATURE
180°F (82°C) Continuous
200°F (93°C) Intermittent

MOUNTING FLANGE SAE "C"

SHAFT OPTIONS SAE "C" spline or
Straight Keyed

WEIGHT
- Flange Mounted 110 lbs. (50.0 kg)

BEARING B-10 LIFE**
- 1000 PSI (70 BAR) 100,000 Hrs.
- 2000 PSI (140 BAR) 45,000 Hrs.
- 3000 PSI (210 BAR) 11,700 Hrs.

* Not to exceed 5 minutes
** Based on operation at 1800 RPM and maximum swashplate angle.

Performance Characteristics L-50 Open Circuit Pump

Outlet Flow - GPM

Inlet Pressure vs. Speed

Swashplate Angle vs. Shaft Speed

Input Horsepower

Noise Levels - db(a)
Measured 3.3 ft. (1 m) from pump - 1800 RPM

QUIET L-50

Pressure - PSI 0 500 1000 1500 2000 2500 3000
Full Flow 74 75 76 77 78 80 82
Dead Head -- 70 71 73 75 76 78

SUPER QUIET L-50

Pressure - PSI 0 500 1000 1500 2000 2500 3000
Full Flow 70 70.5 71 71.5 72 72.5 73.5
Dead Head -- 60.5 64.5 67 68 69.5 70

NOTE: Noise Data per JIS B-6450-1984 @ 120°F (49°C).

Note: Performance curves based on 120°F oil temperature and ISO VG46 oil, and are representative of this series size.
Frame Size 50 - Variable Displacement Pump Installation Drawings

End Cap Porting

SAE Spline Shaft

Volumetric Efficiency - Percent

Overall Efficiency - Percent
Frame Size 70 - Variable Displacement Pump Specifications

**DELIVERY AT MAX. RPM**
41.0 GPM (155 l/min)

**MIN INLET PRESSURE**
5" Hg Vacuum (0.8 BAR abs.)

**FILTRATION**
- Inlet: 150 Mesh
- Return Line: 25 Micron

**CASE PRESSURE**
10 PSI (0.7 BAR) Max.

**FLUID TEMPERATURE**
180°F (82°C) Continuous
200°F (93°C) Intermittent

**MOUNTING FLANGE**
SAE "C"

**SHAFT OPTIONS**
SAE "C" spline or Straight Keyed

**AUXILIARY PAD OPTION**
SAE "A"

**WEIGHT**
Flange Mounted: 120 lbs. (54.5 kg)

**BEARING B-10 LIFE**
- 1000 PSI (70 BAR): 100,000 Hrs.
- 2000 PSI (140 BAR): 48,200 Hrs.
- 3000 PSI (210 BAR): 12,500 Hrs.

- Not to exceed 5 minutes
- Based on operation at 1800 RPM and maximum swashplate angle.

Performance Characteristics L-70
Open Circuit Pump

**Outlet Flow - GPM**

**Inlet Pressure vs. Speed**

**Swashplate Angle vs. Shaft Speed**

**Input Horsepower**

**Noise Levels - db(a)**
Measured 3.3 ft. (1 m) from pump - 1800 RPM

**QUIET L-70**
- Pressure:
  - 0 500 1000 1500 2000 2500 3000
  - Full Flow: 78 77 77.5 78 79 80.5 82
  - Dead Head: 71 72 73 76 78 80

**SUPER QUIET L-70**
- Pressure:
  - 0 500 1000 1500 2000 2500 3000
  - Full Flow: 68.5 71 72 72 73 74 75.5
  - Dead Head: 62.5 66 68.5 69.5 71 71.5

*Note: Performance curves based on 120°F oil temperature and ISO VG46 oil, and are representative of this series size.*

*NOTE: Noise Data per JIS B-6350-1984 @ 120°F (49°C).*
Frame Size 70 - Variable Displacement Pump Installation Drawings

**Series L**

**Technical Data**

**Delivery Adjustments**
- Screw (CAE turn changes)
- Max displacement by 0.308 in³/rev (5.05 cc/rev)

**Inlet and Outlet Ports**
- T=3000 PSI
- SAE Split Flange

**Full Th. Depth 20**

**Inches** (millimeters)
- 12.6 (320)
- 10.1 (256.5)
- 11.81 (300)
- 1.25 (31.75)
- 0.67 (17)

**Drain Connection**
- %14 UNF PB

**Control Location**
- For CW rotation

**Compensator Pressure Adjustment Screw**
- CCW rotation

**Rotation**
- CW

**Conversion for CW Rotation**
- 1.25 (31.75)

**Control Location**
- 6.37 (161.9)

**End Cap Porting**

**SAE Spline Shaft**

**Side Porting (X)**

<table>
<thead>
<tr>
<th>Direction</th>
<th>Rotation</th>
<th>Port A</th>
<th>Port B</th>
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</thead>
<tbody>
<tr>
<td>CW</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CCW</td>
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</tr>
</tbody>
</table>

**Volumetric Efficiency - Percent**

**Overall Efficiency - Percent**

**Input Shaft**
- SAE "C"
- 1.167 (29.634) Pitch Dia
- 30° Pressure Angle
- 14 Teeth 3° Pitch

**Effeciency-Pct**
- 1000 PSI
- 3000 PSI

**Shaft Speed - RPM**
- 500
- 1000
- 1500
- 2000
- 2500
- 3000
Control Options

Pressure Compensator Control (PC)

The pressure compensator control automatically adjusts pump delivery to maintain volume requirements of the system at a pre-selected, adjustable operating pressure. Maximum pump delivery is maintained to approximately 50 psi below the pressure control setting, before being reduced. The pressure compensator control operates on one side of center and has an adjustment range that must be specified. Standard factory range is 500 to 3000 psi. Other optional ranges are:

- 250 - 1000 psi
- 250 - 2000 psi

Positive stops are designed into the control to prevent pressure adjustment in excess of 125% of maximum of the specified range. The adjusting screw is also retained and does not permit minimum pressures below those stated for the selected spring.

Remote Pressure Compensator Control (RC)

- Remote adjustment of pressure compensator
- Provides versatility in matching pressure compensator setting to duty cycle and function requirements
- Adjusted via an external relief valve
- A port on the control housing is provided for connecting to the relief valve
- Remotely variable to maximum operating pressure

Flow And Pressure Compensator Control (FP)

This combination flow and pressure compensator provides a highly efficient, extremely controllable system at lowest possible noise levels. When used with load sensing control valves, maximum benefit of this pump and its controls capability can be achieved.

The pump control has a sensing port that is connected so as to measure pressure drop across a variable or fixed orifice and automatically adjust the pump displacement to match system flow demand. The standard pressure drop is 200 psi with 100 psi or 300 psi optional selections.

When system flow is not required and the sensing port is drained, the pump standby pressure will equal the selected load sensing differential.

- Low standby pressures prevent excessive heat build-up in the pump
- Eliminates unnecessary horsepower drain when hydraulic functions are idle
- Can be used in multiple function systems to provide within its capacity, the total fluctuation of pressure and gallonage
- Can be used effectively to provide constant flow when shaft input speed varies

Note: As a general system safeguard, a relief valve is required in all applications using an open circuit pump(s) to protect the circuit from over pressure. It is also necessary to include a directional control device in the system to enable load flow from the pump to zero.
Variable Displacement Pump

L Series
Open Circuit Pump
Frame Size
15 = .913 in$^3$/Rev (15 cc/Rev)
23 = 1.41 in$^3$/Rev (23 cc/Rev)
38 = 2.3 in$^3$/Rev (38 cc/Rev)
50 = 3.15 in$^3$/Rev (50 cc/Rev)
70 = 4.26 in$^3$/Rev (70 cc/Rev)

1: Input Shaft Rotation
R = Clockwise
L = Counterclockwise

2: Seals
B = Buna N
V = Viton

3: Input Shaft Configuration
K = Keyed Shaft
S = Splined Shaft
N = Non-Standard

4: End Cap System Porting
X = Side Porting for Inlet & Outlet
Y = End Porting for Inlet & Outlet

5, 6: Control Type
PC = Pressure Compensator
FP = Flow & Pressure Compensator
RC = Remote Pressure Compensator

7: Electrical Input
X = Not Applicable

8: Compensator High Pressure Setting
1 = 1000 PSI (70 Bar)
2 = 2000 PSI (140 Bar)
3 = 3000 PSI (210 Bar)

9: Flow Compensator Pressure Setting
A = 100 PSI (7 Bar)
B = 200 PSI (14 Bar)
C = 300 PSI (21 Bar)
D = 400 PSI (28 Bar)
E = 600 PSI (42 Bar)
X = Not Applicable

10: Compensator Low Pressure Setting
1 = 1000 PSI (70 Bar)
2 = 2000 PSI (140 Bar)
X = Not Applicable

11: Auxiliary Pump Mounting Pads
A = SAE "A" (For use with Side Ports only, Option 4X)
ΔB = SAE "B" (L70 Only; For use with Side Ports Only, Option 4X)
X = Not Applicable

12: Special Design
K = Super Quiet Version
X = Quiet Version

Δ = Non-Standard
**SAUER-DANFOSS Hydraulic Power Systems - Market Leaders Worldwide**

SAUER-DANFOSS is a world leader in the design and manufacture of Hydraulic Power Systems. Research and development resources in both North America and Europe enable SAUER-DANFOSS to offer a wide range of design solutions utilizing hydraulic power system technology.

SAUER-DANFOSS specializes in integrating a full range of system components to provide vehicle designers with the most advanced total-design system.

SAUER-DANFOSS is Your World Source for Controlled Hydraulic Power Systems.

<table>
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<tr>
<th>Heavy Duty Axial Piston Pumps and Motors</th>
<th>Heavy Duty Bent Axis Variable Motors</th>
<th>Cartridge Motors/Compact Wheel Drives</th>
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<td>Microcontrollers and Electrohydraulic Controls</td>
<td>Hydrostatic Transmission Packages</td>
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<td>Open Circuit Axial Piston Pumps</td>
<td>Gear Pumps and Motors</td>
<td>Genuine Service Parts</td>
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